OPTICAL BRANCHING UNIT AND WAVEGUIDE TYPE OPTICAL COUPLER MODULE USED FOR SAME UNIT

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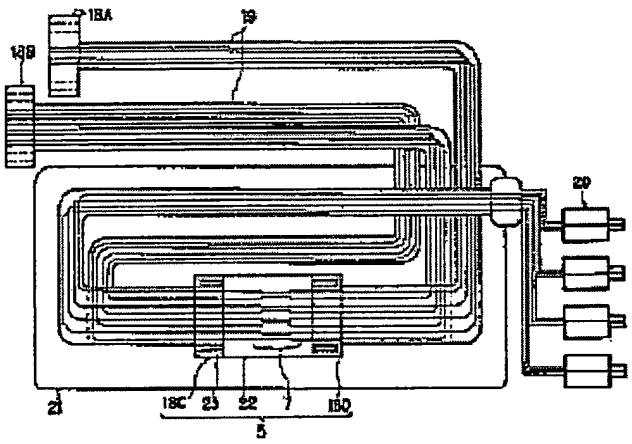
Abstract of **JP6018744**

PURPOSE:To miniaturize an optical coupler, to simplify a surplus length processing and to simplify a production process by providing an optical coupler module formed as a chip, connecting the module with a connector and also linking the distance between connectors with an optical fiber ribbon.
CONSTITUTION:The optical branching unit is provided with a multi-core connector 18A with four cores stored used as a communication port, a multi-core connector 18B with eight cores stored used as an inspection port, multi-core connector modules 18C and 18D with eight cores stored and connected with a waveguide type optical module 22 where an optical coupler unit 7 is arranged, four-core optical fiber ribbon 19, a single-core connector 20 used as a communication port, a surplus length tray 21 and a connecting pin 23 for positioning the optical coupler module 22 and the multi-core connector modules 18C and 18D. And the waveguide type optical coupler module 22 is the chip with four integrated cores, and the multi-core connector modules 18C and 18D are connected with the module 22.



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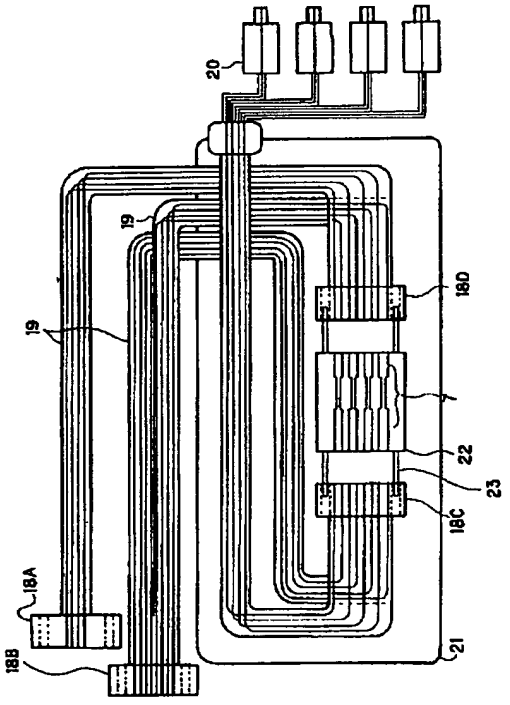
(54)【発明の名称】　光分岐ユニット及びこのユニットに用いる導波路型光カプラモジュール

(57)【要約】

【目的】　光通信分野での光回線アクセス装置に用いられ、光線路に光挿入分岐機能を付加し、回線の試験又はモニタを可能とした光分岐ユニット及びこのユニットに用いる導波路型光カプラモジュールを提供する。

【構成】　光分岐ユニットの光カプラ２２を無調心で接合し得るようにモジュール化すると共に、光ファイバをテープ心線１９とすることにより、小型化、組立容易化、経済化を得ることができる。



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【特許請求の範囲】

【請求項1】　光線路試験を行なう場合に、光線路へ試験光を挿入するための光回線アクセス装置に用いる光分岐ユニットにおいて、

二つの2N心収容の多心コネクタモジュールに接続可能で、N個集積してチップ化した導波路形光カプラモジュールを備える一方、

一方の通信ポートに当るN心収容形多心コネクタと、二つの試験ポートに当る2N心収容形多心コネクタと、上記一方の通信ポートに対応する他方の通信ポートに当るN心多心コネクタとを備え、

上記N心収容形多心コネクタと上記2N心収容形多心コネクタのうち一方の試験ポートに対応するN心とをテープ心線にて交互に収容した一方の上記2N心収容の多心コネクタモジュールに接続し、

上記N心単心光コネクタと上記2N心収容形多心コネクタのうち他方の試験ポートに対応する残りのN心とをテープ心線にて交互に収容した他方の上記2N心収容の多心コネクタモジュールに接続し、

たことを特徴とする光分岐ユニット。

【請求項2】　請求項1記載の光分岐ユニットに用いるカプラモジュールであって、

シリコン基板上に形成されたSiO_2層上に所定の間隔を有して並設する複数の光ファイバに対応して形成された光導波路及び該光導波路から所定の距離を有して互いに平行に形成された少なくとも2本以上の位置決め用のガイド溝を有する光導波路基板と、

前記ガイド溝に嵌合するガイドピンを有し、複数の該ガイドピンが前記ガイド溝内に光導波路基板の両端面から突出させ接着固定させるガイドピン固定部材と、

前記ガイドピンが前記ガイド溝に嵌合したとき前記光導波路に突き合わせて光結合するよう所定の位置決めされた光ファイバを保持する多心光コネクタと、

前記光導波路と多心光コネクタとの光結合状態を保持するクリップとを、

備えたことを特徴とする導波路型光カプラモジュール。

【請求項3】　請求項2記載の導波路型光カプラモジュールにおいて、前記光導波路基板の両端面における光導波路の各軸中心とガイドピンの各軸中心との高さが一致し、且つ同一直線上に配置されていることを特徴とする導波路型光カプラモジュール。

【請求項4】　請求項2記載の導波路型光カプラモジュールにおいて、光導波路の上部基準面とガイドピン固定部材との間には、空間を設けていることを特徴とする導波路型光カプラモジュール。

【請求項5】　請求項2記載の導波路型光カプラモジュールにおいて、光ファイバの端面及び光導波路の光入出射端面をそれぞれ等しい角度θで斜めに研磨していることを特徴とする導波路型光カプラモジュール。

【請求項6】　請求項2記載の導波路型光カプラモジュールにおいて、導波路型光カプラモジュールの通信線路上には試験光除去用の光フィルタを実装したことを特徴とする導波路型光カプラモジュール。

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【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、光通信分野での光回線アクセス装置に用いられ、光線路に光挿入分岐機能を付加し、回線の試験又はモニタを可能とした光分岐ユニット及びこのユニットに用いる導波路型光カプラモジュールに関する。

【0002】

【従来の技術】光線路試験システムにあって従来（特開平2－1632号）のものは、図16に示すように局内用光ファイバケーブル9と局外用光ファイバケーブル10間である通信用光ファイバ11間に光分岐ユニット5を介在させ、この光分岐ユニット5には通信ポート1，2及び試験ポート3，4を備え、この試験ポート3，4にて光挿入、光分岐を行なっている。試験ポート3，4には試験心線選択用の1×N光スイッチ13が接続され、更に光ファイバ11の損失や故障点等を測定する光パルス試験器14，制御装置15，試験結果の表示装置16が備えられている。また、光伝送端局12側の光ファイバ11には、試験光除去用の光フィルタ17が配置されている。

【0003】かかるシステムにあっては、試験に当りまず、1×N光スイッチ13にてN本のうちから試験心線を選択し、その選択した心線における光分岐ユニット5の試験ポート3を選択する。そして、光パルス試験器14の試験光は、その光分岐ユニット5を介して局外用光ファイバケーブル10に挿入され、その後方散乱光のレベルを受光することにより、その通信用光ファイバ11の損失・故障点位置等を測定できる。

【0004】この図16にて示される光ファイバケーブル9，10は、数十心以上の光ファイバを収容しており、局外ケーブル10は多心形光ファイバ、局内ケーブル9は単心形光ファイバがそれぞれ使用されている。局外ケーブル10を成端し局内ケーブル9と接続することは、通常MDF（主配線架）と呼ばれ、このMDFの中に光分岐ユニットが収容されることになる。

【0005】図17は従来の光分岐ユニットの一例（実開平2－258408号）を示したもので、図16に示す光分岐ユニット5の通信ポート1，2及び試験ポート3，4に対応する通信用ポートの光ファイバ1f，2f，光挿入用ポート3の光ファイバ3f，光分岐用ポート4の光ファイバ4fがそれぞれ光カプラユニット7に個別に接続され、光ファイバ2fはそれぞれ単心フェルール6に接続されると共に光ファイバ1f，3f等は多心フェルール8に接続されている光分岐ユニット5を示している。

【0006】図18は、従来の光ファイバと光導波路と

の接続における光導波路部品の一例（特開平4－340507号）を示したものである。同図に示すように、光導波路部品27は光導波路31が設けられ位置決め用のガイド28bが形成された光導波路基板28上に光導波路31が設けられている。一方、この光導波路基板28と突き合わせて当接され、光導波路31と接合すべき光ファイバ11の位置決めをする光ファイバ整列溝29bと前記光導波路基板28との位置決めをするためのガイド29dとが形成された光ファイバ整列基板29を用い、前記光導波路基板28と光ファイバ整列基板29との各ガイド28b，29dと嵌合して前記光導波路31と光ファイバ11とを整合させるガイド受30cが形成された固定基板30とを用いて光導波路部品を構成している。

【0007】

【発明が解決しようとする課題】ところで、上記各従来の光分岐ユニットでは、図17にて二組の光カプラユニット7を構成するそれぞれの光カプラは、実際上数mmの円筒形部材であり、図17の如く4心とか8心のみならず、最近においては更に多心の分岐ユニットが形成されつつあることから、装置が大形になりつつある。また、各光カプラには光ファイバ1f，2f，3f，4fが個別に接続されることから製造工程が多く、多心になるほど極めて面倒な工程が必要となる。

【0008】また、図18に示した従来の光ファイバと光導波路との接続では、光ファイバ整列基板29の光ファイバ整列溝29bに光ファイバ11を収容すると同時に光導波路基板28の光導波路31を当接しておかなければ固定基板30で固定ができないという問題がある。そしてその際、光ファイバ11が長さ方向に微妙にずれるおそれがある。さらに、光ファイバ11が多心になるほど光ファイバ整列基板29への組付けが困難になるという問題がある。

【0009】本発明は、前記問題に鑑み、光カプラを小型化し余長処理を小さくまとめると共に光ファイバの接続を簡単化した光分岐ユニット及びこの光分岐ユニットに用いる導波路型光カプラモジュールを提供することを目的とする。

【0010】

【課題を解決するための手段】上述の目的を達成する本発明に係る光分岐ユニットの構成は、光線路試験を行なう場合に、光線路へ試験光を挿入するための光回線アクセス装置に用いる光分岐ユニットにおいて、二つの2N心収容の多心コネクタモジュールに接続可能で、N個集積してチップ化した導波路形光カプラモジュールを備える一方、一方の通信ポートに当るN心収容形多心コネクタと、二つの試験ポートに当る2N心収容形多心コネクタと、上記一方の通信ポートに対応する他方の通信ポートに当るN心多心コネクタとを備え、上記N心収容形多心コネクタと上記2N心収容形多心コネクタのうち一方

の試験ポートに対応するN心とをテープ心線にて交互に収容した一方の上記2N心収容の多心コネクタモジュールに接続し、上記N心単心光コネクタと上記2N心収容形多心コネクタのうち他方の試験ポートに対応する残りのN心とをテープ心線にて交互に収容した他方の上記2N心収容の多心コネクタモジュールに接続したことを基本とする。

【0011】また、本発明に係る光分岐ユニットに用いる導波路型光カプラモジュールの構成は、シリコン基板上に形成されたSiO_2層上に所定の間隔を有して並設する複数の光ファイバに対応して形成された光導波路及び該光導波路から所定の距離を有して互いに平行に形成された少なくとも2本以上の位置決め用のガイド溝を有する光導波路基板と、前記ガイド溝に嵌合するガイドピンを有し、複数の該ガイドピンが前記ガイド溝内に光導波路基板の両端面から突出させ接着固定させるガイドピン固定部材と、前記ガイドピンが前記ガイド溝に嵌合したとき前記光導波路に突き合わせて光結合するよう所定の位置決めされた光ファイバを保持する多心光コネクタと、前記光導波路と多心光コネクタとの光結合状態を保持するクリップとを備えたことを特徴とする。

【0012】前記導波路型光カプラモジュールにおいて、光導波路基板の両端面における光導波路の各軸中心とガイドピンの各軸中心との高さが一致し、且つ同一直線上に配置するようにしてもよい。

【0013】前記導波路型光カプラモジュールの光導波路基板において、光導波路の上部基準面とガイドピン固定部材との間に、空間を設けるようにしてもよい。

【0014】前記導波路型光カプラモジュールの光導波路基板において、光ファイバの端面及び光導波路の光入出射端面をそれぞれ等しい角度θで斜めに研磨するようにしてもよい。

【0015】導波路型光カプラモジュールの通信線路上には、試験光除去用の光フィルタを実装するようにしてもよい。

【0016】

【作用】従来の如き光カプラユニットを用いることなくチップ化した光カプラモジュールを備えてコネクタと接続し、しかもコネクタ間はテープ心線にてつなげることにより、光カプラの小型化と余長処理が簡略化でき、また集積化、テープ化によって製造工程も極めて簡単となった。

【0017】前記導波路型光カプラモジュールは、光導波路基板に形成された位置決め用のガイド溝にガイドピンを嵌合して位置決めし且つ当該光導波路基板の両端面より該ガイドピンを突出させ、ガイドピン固定部材により接着固定させる。次いで、この光導波路基板と多心光コネクタを該光導波路基板に設けられた該ガイドピンにより嵌合させる。このガイドピンが光導波路基板と多心光コネクタとに嵌合した状態において、光導波路基板に

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設けられた光導波路と多心光コネクタに保持された多心光コネクタとが整合され、クリップにて光結合状態が保持される。これにより多心の光導波路と光ファイバとを無調心で接合することが可能となる。

【0018】

【実施例】以下、図1～図15を参照して本発明の実施例について説明する。

【0019】先づ、本発明の光分岐ユニットの実施例を図1～図5について参照しながら説明する。

【0020】〔実施例1〕図1は第1実施例の光分岐ユニットであり、18Aは通信ポートに当る4心収容の多心コネクタ、18Bは試験ポートに当る8心収容の多心コネクタ、18C，18Dは光カプラユニット7を配した導波路型光カプラモジュール22に接続される8心収容の多心コネクタモジュール、19は4心テープ心線、20は通信ポートに当る単心コネクタ、21は余長トレイ、23は光カプラモジュール22と多心コネクタモジュール18C，18Dとを位置合せするための接続用ピンである。ここにおいて、導波路型光カプラモジュール22は、4心が集積化されたチップであり、このモジュール22に対して多心コネクタモジュール18C，18Dが接続できるようになっている。

【0021】図2は図1に示す光カプラモジュール22とコネクタモジュール18C，18Dとを接続して全体として光分岐ユニット5が完成した図を示している。

【0022】〔実施例2〕図3は第2実施例の光分岐ユニットであり、図1との差異は導波路型光カプラモジュール22の通信線路内に試験光除去用の光フィルタ17が挿入され、しかも通信線路に対して反射を防ぐべく適宜角度を持たせたものである。そして、この光フィルタ17の挿入用の穴24は、エッチング等により作られる。このフィルタ17の存在によりシステムの簡易化や経済化を図ることができる。

【0023】〔実施例3〕図4は第3実施例の光分岐ユニットであり、導波路型光カプラモジュール22に備えられるフィルタ基板25には通信線路の配列に合わせて光フィルタ17が備えられる。しかも、図3の場合と同様通信線路に対して反射を防ぐため適切な角度を持たせた溝26に嵌められ接着剤で固定される。フィルタ基板25及びフィルタ17は図5（a）（b）に示すようにたんざく形状にあるいは橋げた形状となるように構成され得る。この場合、図3に示す構造と比較してエッチングによらず通常の切削加工ができ、導波路型光カプラモジュール22の作成が容易になった。

【0024】上述した光分岐ユニットにおいては、光カプラモジュールの内部についての説明を省いているが、この光カプラとしては光分岐ができればよく、以下に示す実施例に限定されず、種々の構造が考えられる。

【0025】次に、本発明の光分岐ユニットに用いて好適な導波路型光カプラモジュールの実施例について図6～図15を参照しながら説明する。

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【0026】〔実施例4〕図6は、本発明の第4実施例であり、導波路型光カプラモジュール22は、光導波路基板32と、ガイドピン固定部材33と、多心光コネクタ（8MT）18と、クリップ34と、ガイドピン23とにより構成されており、光導波路と光ファイバとの接合状態を示した図である。

【0027】図7は、図6の分解図であり、光導波路基板32には、光導波路31と位置決め用ガイド溝36とが設けられ、該ガイド溝36にガイドピン23を嵌合して位置決めし且つ光導波路基板32の両端面からガイドピン23の一部を突出させた状態でガイドピン固定部材33により接着剤35にて接着固定され、該ガイドピン23は光導波路基板32に保持される。多心光コネクタ（8MT）18は、前記ガイドピン23が前記ガイド溝36に嵌合したとき前記光導波路31に突き合わせて光結合するよう所定の位置決めされた光ファイバ11を保持しており、該多心光コネクタ（8MT）18のガイドピン穴37に突き合わされることにより、接合が可能となる。クリップ34は、前記光導波路31と多心光コネクタ（8MT）18との光結合状態を保持するものである。

【0028】図8は、図7に示した多心光コネクタ（8MT）18の一部破断斜視図であり、通信ポート及び試験ポートに当たる2つの4心テープ心線19を多心光コネクタのフェルールに挿入したものである。ここで2つの4心テープ心線19，19のそれぞれの心線は、交互に収容され対向する導波路型光カプラモジュール22と接続される。

【0029】図9は、光導波路31とガイドピン23の相対位置関係を示す端面図であり、光導波路基板32は、シリコン基板上に形成されたSiO_2層上に所定の間隔を有して並設する複数の光ファイバ11に対応して形成された光導波路31及び該光導波路31から所定の距離Wを有して互いに平行に形成された少なくとも2本以上の位置決め用のガイド溝36を設けている。また、ガイドピン固定部材33は、前記ガイド溝36に嵌合するガイドピン23を固定するもので、複数の該ガイドピン23が前記ガイド溝36内光導波路基板32の両端面から突出させた状態で接着固定している。

【0030】光導波路基板32の端面において光導波路基板32に形成された光導波路31は複数本、例えば本実施例では、8本の光導波路31が設けられている。これらの光導波路31は、図9に示すように、各軸中心が光導波路基板32の上面を基準とする基準面38から所定の深さhの位置に、且つ各軸中心距離が所定の間隔P，で並んで設けられている。また、位置決め用のガイド溝36は両端の光導波路31の軸中心から所定の距離Wの位置に、且つガイドピン23の軸中心の深さが前記光導波路31の深さと一致するよう設定し形成され、後に

接続されるガイドピン２３と嵌合するガイドピン穴３７を有する多心光コネクタ（８ＭＴ）１８が保持する複数の光ファイバ１１の夫々の間隔P_f及びガイドピン穴３７の間隔P_cとの相対位置を夫々合致させて同一直線上に配置される。

【００３１】一方、ガイドピン固定部材３３は、光導波路基板３２と対向する下面３３ａが凹部を形成しており、深さｄと光導波路基板３２の基準面３８からガイドピン２３の頂点の高さh_1とが等しく（$d=h_1$）設定されている。そしてガイドピン２３は光導波路基板３２のガイド溝３６の周面とガイドピン固定部材３３の下面３３ａとにより挟持され、固定される。そして、光導波路基板３２の両端面と光導波路３１の各両端面とガイドピン固定部材３３の両端面は夫々面一とされている。

【００３２】図１０は、図９におけるガイドピン２３をガイド溝３６に挟持し接着固定したものであり、ガイド溝３６のガイドピン２３の下面側の空間内及びガイドピン固定部材３３と光導波路基板３２との当接側の空間内のみ接着剤３５を充填して接着固定しており、光導波路３１の上部基準面３８とガイドピン固定部材３３との間には、光導波路３１に影響を与えないために接着剤３５の充填を避け、空間を形成している。

【００３３】光導波路基板３２、ガイドピン固定部材３３等は、基板材料として例えば、単結晶シリコンを用い、位置決め用ガイド溝３６等をシリコンの異方性エッチング技術によりＶ溝形成することが可能である。また、シリコン基板上に容易に構成可能な火炎堆積法による石英導波路を用いることができ高精度に形成される。

【００３４】図１０に示した光導波路基板３２の光導波路３１と多心光コネクタ（８ＭＴ）１８の光ファイバ１１とがガイドピン２３により正確に整合し、且つ各整合端面同志が当接される。これにより光導波路３１と光ファイバ１１とは無調心で正確に接合される。

【００３５】〔実施例５〕図１１は、本発明の第５の実施例であり、導波路型光カプラモジュール２２の接合部の斜視図を示し、図１２は導波路型光カプラモジュール２２の側面図を示す図である。

【００３６】図１１，図１２において前記第４の実施例の図６～図１０において説明したものと同時の部分については同一符号を付し、且つ同等部分の説明は省略する。

【００３７】第５の実施例に係る導波路型光カプラモジュールは、図１１，１２に示すように、光導波路３１と多心光コネクタ（８ＭＴ）１８の光ファイバ１１とがガイドピン２３により整合される際、当接される多心光コネクタ（８ＭＴ）１８の光ファイバ１１の露出する多心光コネクタ１８の端面１８ａ及び光導波路３１の光入出射端面２２ａとがそれぞれ等しい角度θで斜めに研磨されたものである。第５の実施例は、前記第４の実施例の光導波路３１と多心光コネクタ（８ＭＴ）１８の光ファイバ１１との接合部分で生じるフレネル反射による反射戻り光を低減するためのものである。例えば、光ファイバの１１の露出する多心光コネクタ１８の端面１８ａ及び光導波路３１の光入出射端面２２ａを約８度以上の角度θで高精度な角度研磨を行うことにより、フレネル反射による反射光が導波モードになるのを防ぎ、またフレネル反射による伝搬光の接続損失の低減が図れる。

【００３８】〔実施例６〕図１３は、本発明の第６の実施例であり光導波路基板３２とガイドピン固定部材３３との関係を示す端面図を示し、図１４は図１３の嵌合状態を示す図である。

【００３９】第６の実施例に係る導波路型光カプラモジュールは、図１３，１４に示すように、ガイドピン固定部材３３は光導波路基板３２の上面及び両側面を囲うようにその断面形状が逆凹状に形成され、ガイドピン２３は、前記第４の実施例と同様に挟持される。

【００４０】第６の実施例では、図１３に示すように、光入出射端面２２ａの大きさに制限を加えているため、光導波路基板３２の両側面３２ａ，３２ｂをガイド溝３６の手前まで削っており、側面３２ａから３２ｂ間の幅D_1に対抗するようガイドピン固定部材３３の下面３３ａが等しく（$D=D_1$）設定される。また、光導波路基板３２と対抗する下面３３ａが凹条とされた深さH_1と光導波路基板３２の下面３２ｃからガイドピン２３の頂点の高さＨとが等しく（$H=H_1$）設定され、ガイドピン２３が光導波路基板３２のガイド溝３６の周面とガイドピン固定部材３３の下面３３ａとにより挟持され、光導波路基板３２の両側面３２ａ，３２ｂに接着剤３５により接着固定される。

【００４１】第６の実施例は、前記第４の実施例のガイドピン２３の固定において、より強度のあるガイドピン２３の固定ができる。また、光導波路基板３２とガイドピン固定部材３３との接着においても、より強度な接着固定が可能となり、ガイドピン２３のガイド溝３６に対する脱着も可能となる優れた効果がある。

【００４２】〔実施例７〕図１５は、第７の実施例であり本発明の光分岐ユニットの試作構成を示す図である。

【００４３】第７の実施例は、図１５に示すように光分岐ユニットを試作したものであり、光分岐ユニットの簡素化が図れた。同図に示すように、余長処理部を波線で表しており、テープ化による複雑さが無いのが確認される。また、導波路型光カプラモジュール２２をユニット内に横向きに立てて実装することによりテープ心線１９の余長処理部でのねじれやひずみがなくテープ心線１９の組付けができる。

【００４４】試作品の測定結果を「表１」に示す。本試作においての導波路型光カプラモジュール２２については、直線導波路型光モジュールを用いて行った結果である。

【００４５】

【表1】

測定結果一覧表

心線 No		#1	#2	#3	#4	#5	#6	#7	#8
接続損失(dB)		0.69	0.87	0.72	0.77	0.61	0.60	0.57	0.80
反射減衰量(dB)		49	46	52	47	51	47	52	47
温度サイクル特性	MAX値(dB)	0.16	0.13	0.10	0.15	0.07	0.04	0.05	0.06
	MIN値(dB)	-0.14	-0.05	-0.07	-0.16	-0.03	-0.02	-0.04	-0.03
	変動量(dB)	0.30	0.18	0.17	0.31	0.10	0.06	0.09	0.09
偏光Loss特性(dB)		0.09	0.11	0.14	0.12	0.10	0.05	0.10	0.07

【００４６】上記第４～第６の実施例では、光導波路基板３２に位置決め用のガイド溝３６を一体に形成したガイドピン方式の場合を示したが、本発明はこれに限るものではなく、例えば他の形状や光導波路と位置決め用のガイド溝とを各別に形成し、それぞれ所定の位置関係で正確に固定してもよい。また、上記実施例において８本の光導波路３１を形成した場合を示したが、本発明はこれに限るものではなく、多数の光導波路と光ファイバとを接合する場合を用いても本発明の効果を得ることができる。また、この光カプラとしては光分岐ができればよく種々の構造が考えられる。

【００４７】

【発明の効果】以上説明したように本発明では、集積化チップ化及びテープ化を図ることにより、構成の簡素化、組立の簡易化が図れるので、光線路における光アクセス部分を小型で経済的なものが得られる。また、本発明の導波路型光カプラモジュールによれば、光導波路と光ファイバとを無調心で且つ極めて容易に光結合させることが可能となり、光導波路と光ファイバとの接続を多心一括で行うことが可能となり、作業能率が大幅に向上し、コストの低減が図られる。また、ガイドピン及びクリップによる接続のため、光導波路と光ファイバの脱着が可能となり、光導波路チップ等の取り換えが容易にでき、且つ接続部の伝送損失を小さくすることができるなど、各部品の構成が簡単であるという優れた効果がある。

【図面の簡単な説明】

【図１】本発明の第１の実施例を示す構成図である。

【図２】図１の結合完了を示す構成図である。

【図３】本発明の第２の実施例を示す構成図である。

【図４】本発明の第３の実施例を示す構成図である。

【図５】本発明の第３の実施例におけるフィルタ基板と光フィルタとを示す斜視図である。

【図６】本発明の第４の実施例を示す組立斜視図である。

【図７】図６の分解斜視図である。

【図８】多心コネクタモジュール１８Ｃ，１８Ｄの一部破断斜視図である。

【図９】光導波路基板とガイドピン固定部材との関係を示す端面図である。

【図１０】光導波路基板とガイドピン固定部材との嵌合状態を示す図である。

【図１１】本発明の第５の実施例を示す組立斜視図である。

【図１２】光導波路と光ファイバとの接合状態を示す図である。

【図１３】本発明の第６の実施例を示す端面図である。

【図１４】光導波路基板とガイドピン固定部材との嵌合状態を示す図である。

【図１５】本発明の第７の実施例を示す試作構成図である。

【図１６】光線路試験システムの構成図である。

【図１７】従来の光分岐ユニットを示す構成図である。

【図１８】従来の光導波路と光ファイバとの接合を示す組立斜視図である。

【符号の説明】

１，２　通信ポート
３，４　試験ポート
５　光分岐ユニット
６　単心フェルール
７　光カプラユニット
８　多心フェルール
９　局内ケーブル
１０　局外ケーブル
１１　光ファイバ
１２　光伝送端局

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１３　１×N光スイッチ
１４　光パルス試験器
１５　制御装置
１６　表示装置
１７　光フィルタ
１８　多心光コネクタ
１９　テープ心線
２０　単心コネクタ
２１　余長トレイ
２２　導波路型光カプラモジュール
２３　ガイドピン
２４　光フィルタ挿入用の穴
２５　フィルタ基板

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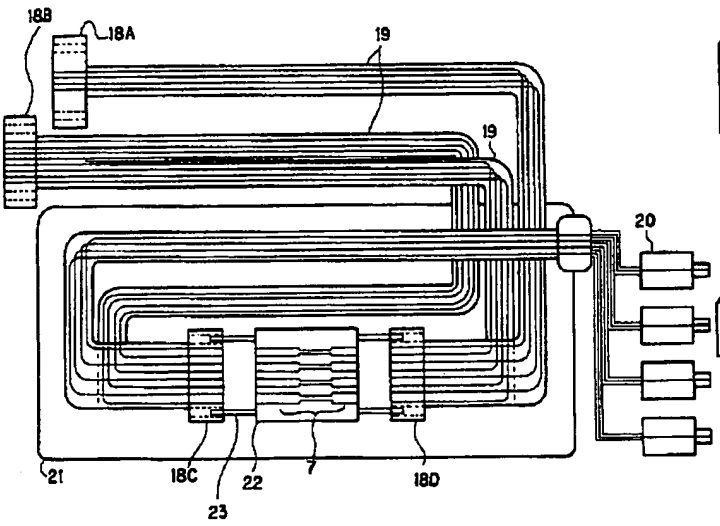
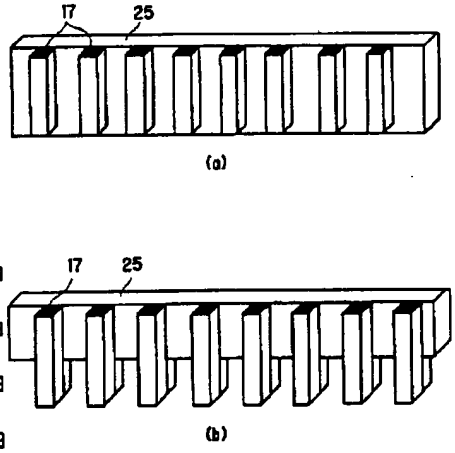
２６　フィルタ基板挿入溝
２７　光導波路部品
２８　光導波路基板
２９　光ファイバ整列基板
３０　固定基板
３１　光導波路
３２　光導波路基板
３３　ガイドピン固定部材
３４　クリップ
10　３５　接着剤
３６　ガイド溝
３７　ガイドピン穴
３８　基準面

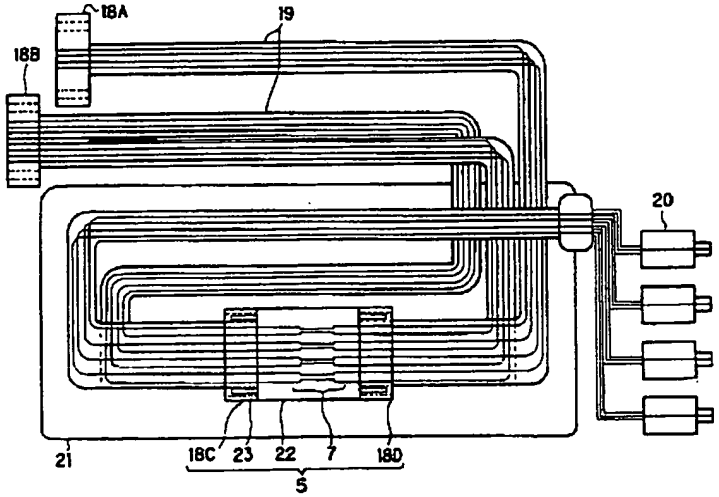
【図１】



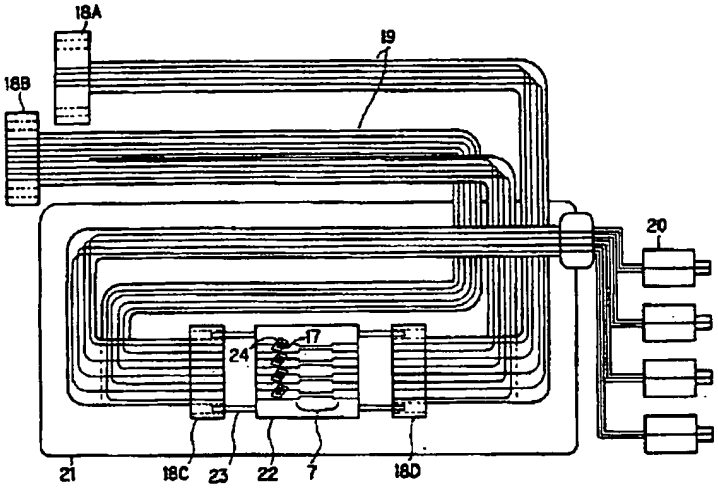
【図５】



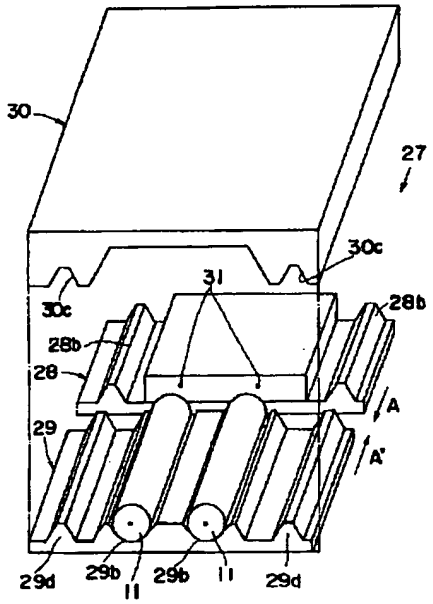
【図２】



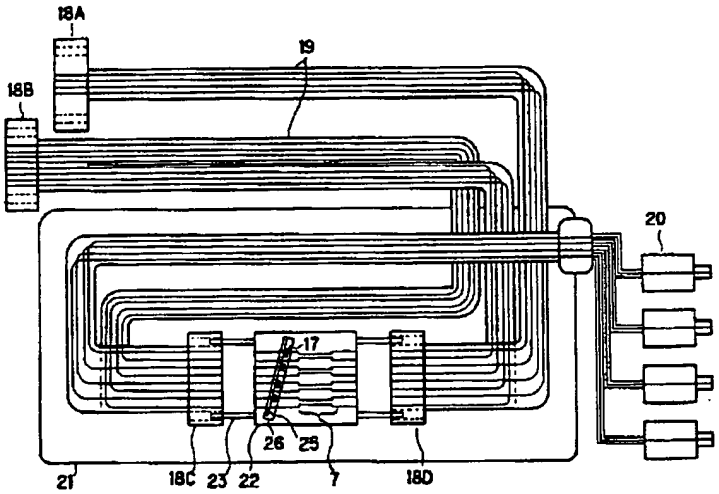
【図3】



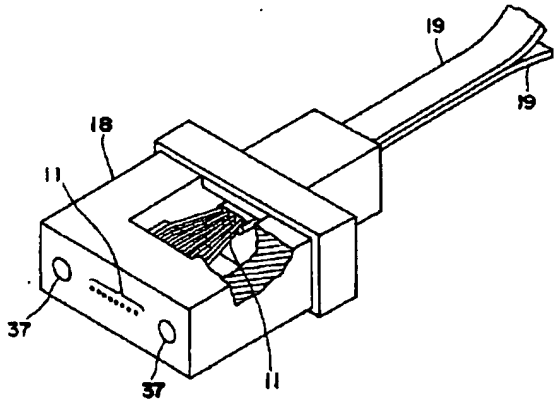
【図18】



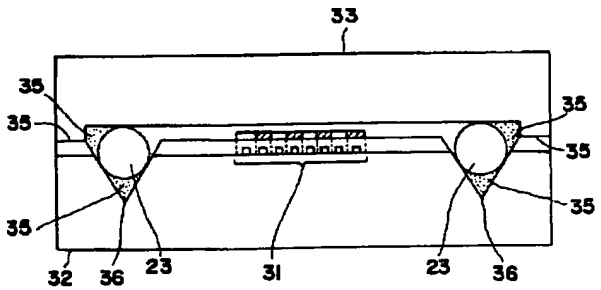
【図4】



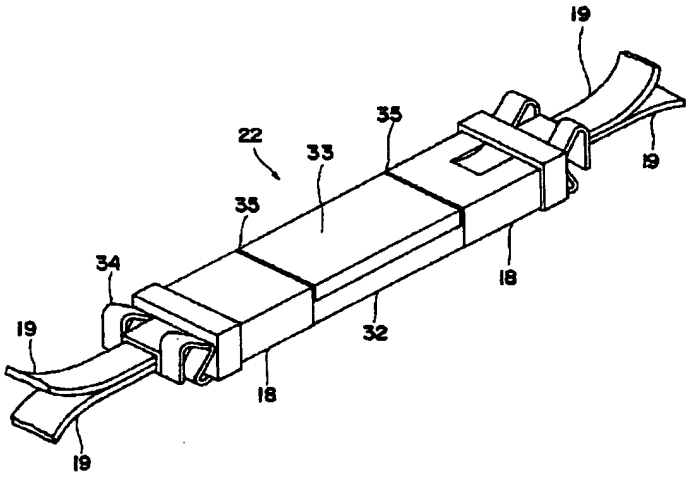
【図8】



【図10】



【図6】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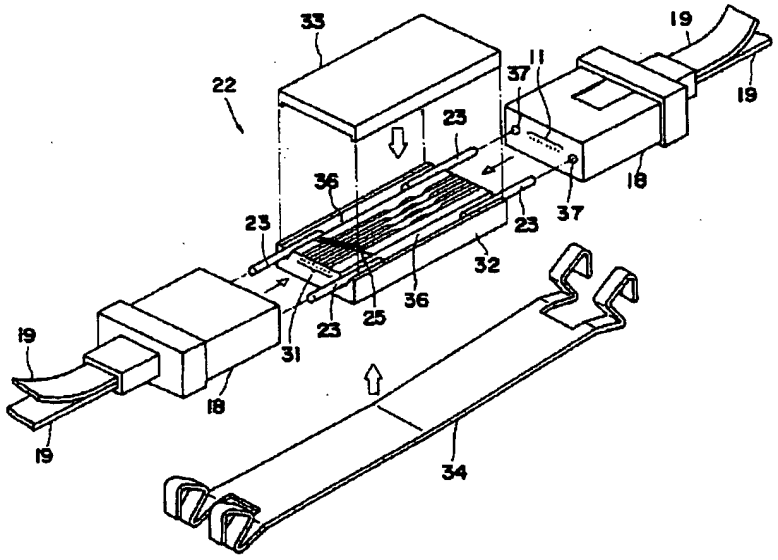
【図7】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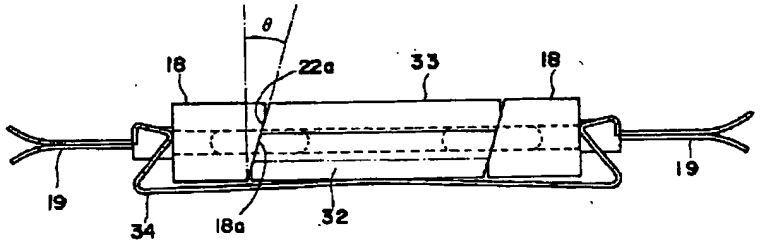
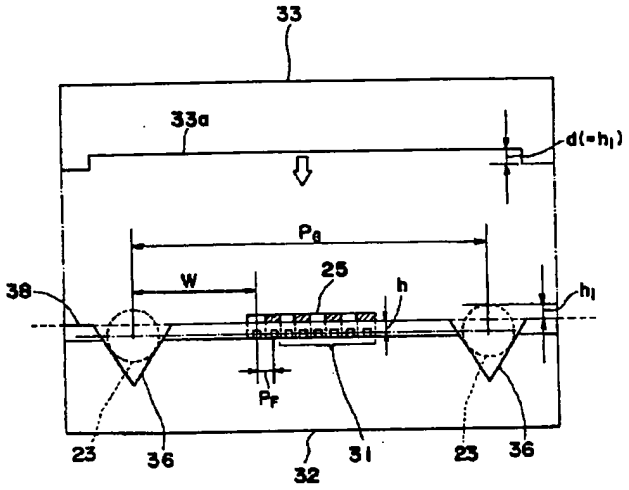
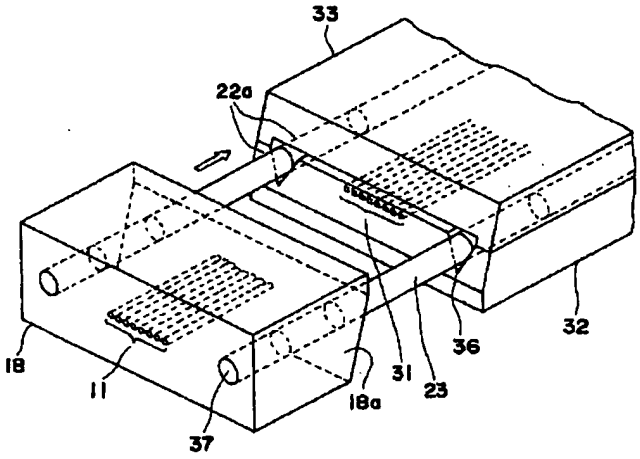
【図12】


θ
18
22a
33
18
19
19
34
18a
32

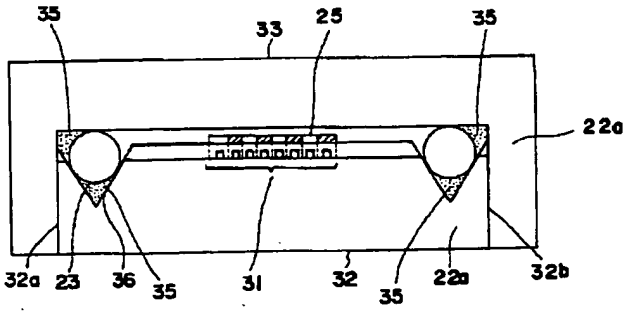
【図9】


33
33a
d(=h1)
PB
W
25
h
h1
38
PF
23
36
31
32
23
36

【図11】


33
22a
32
36
31
23
18
11
18a
37

【図14】


35
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25
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22a
32a
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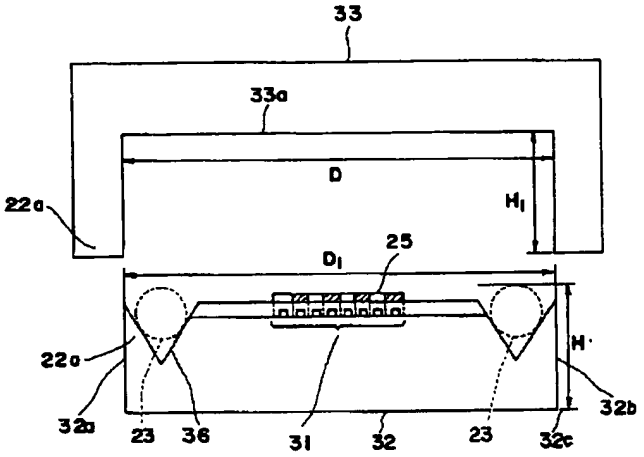
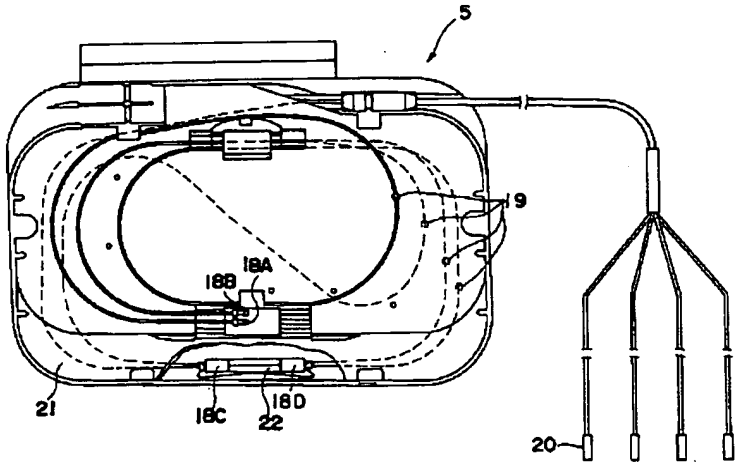
36
35
31
32
35
22a
32b

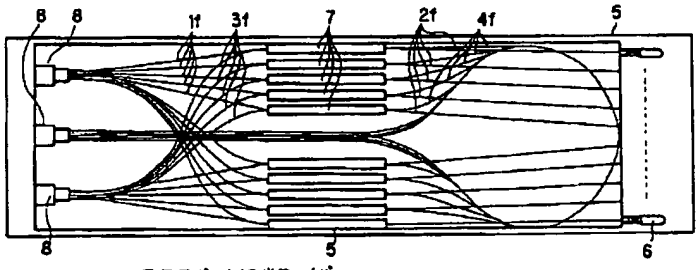
【図１３】



【図１５】

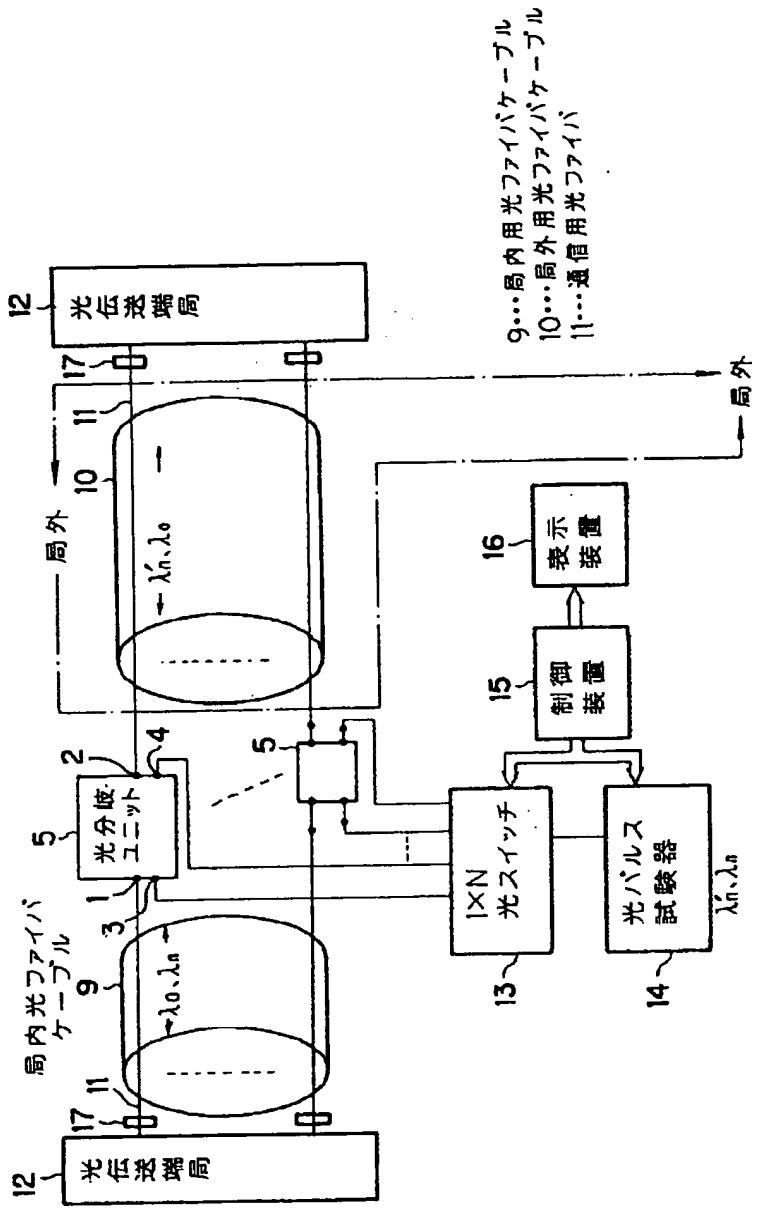


【図１７】



1f…通信用ポート1の光ファイバ
2f…通信用ポート2の光ファイバ
3f…光挿入用ポート3の光ファイバ
4f…光分岐用ポート4の光ファイバ
5…光分岐ユニット
6…単心フェルール
7…光カプラユニット
8…多心フェルール

【図16】



フロントページの続き

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東京都千代田区内幸町一丁目1番6号　日本電信電話株式会社内

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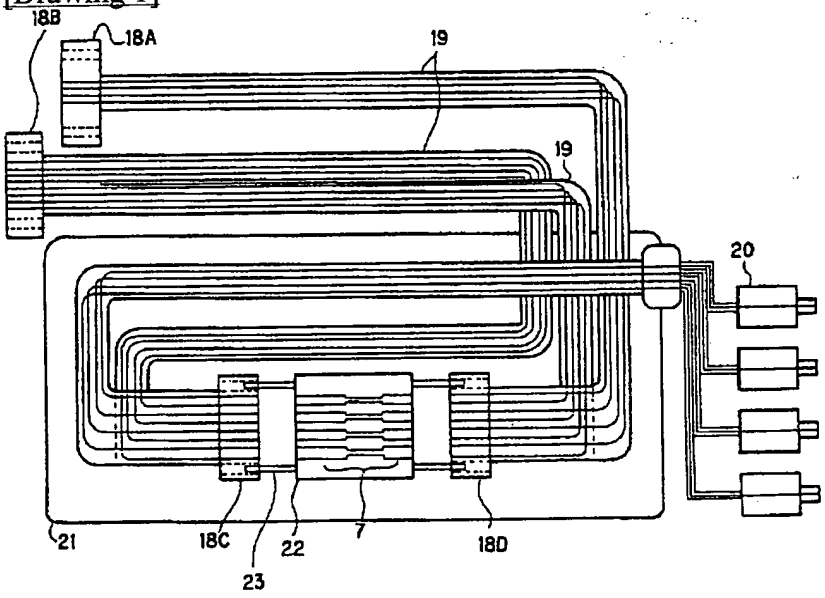
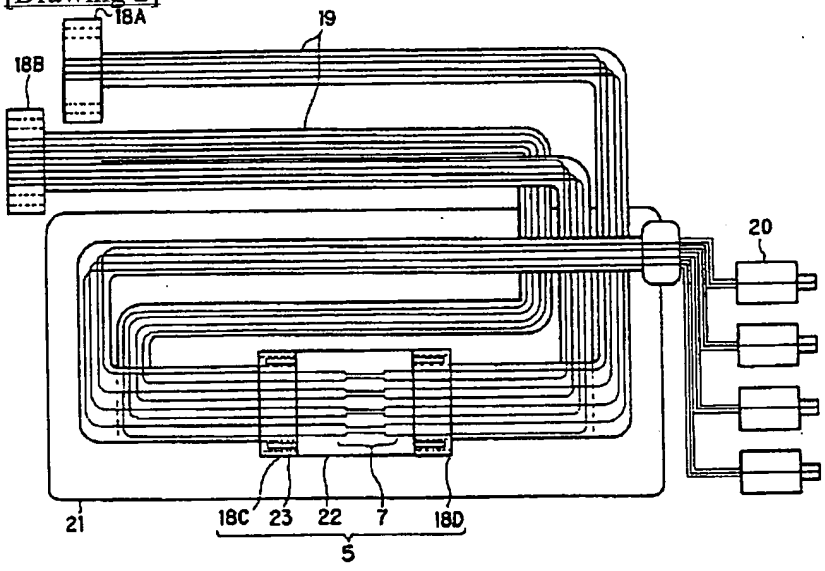
DRAWINGS

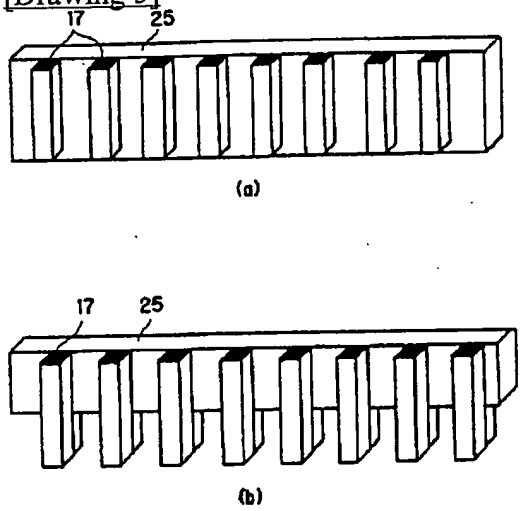
[Drawing 1]



[Drawing 2]



[Drawing 5]



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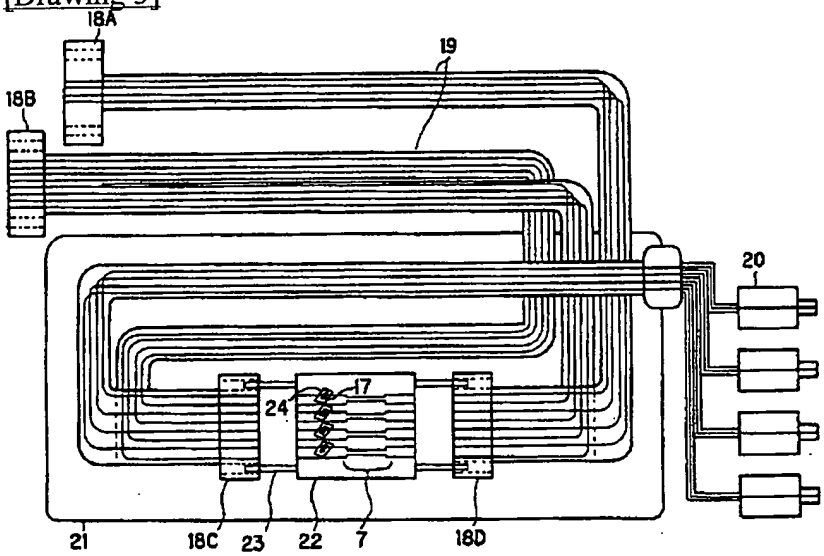

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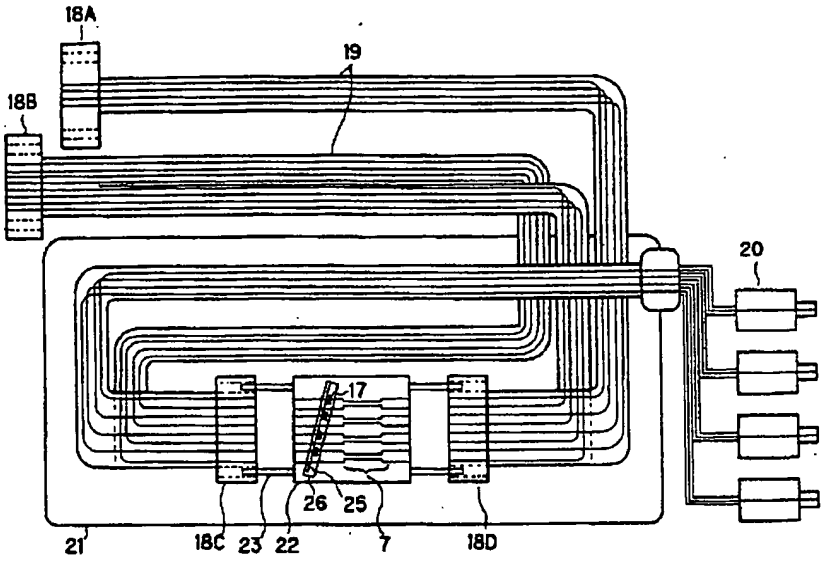

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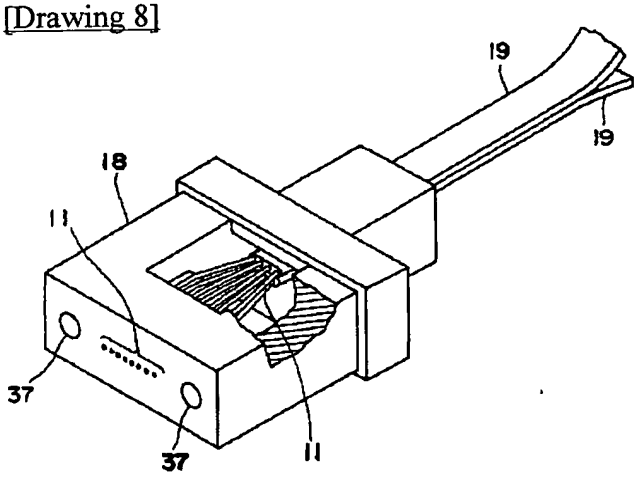
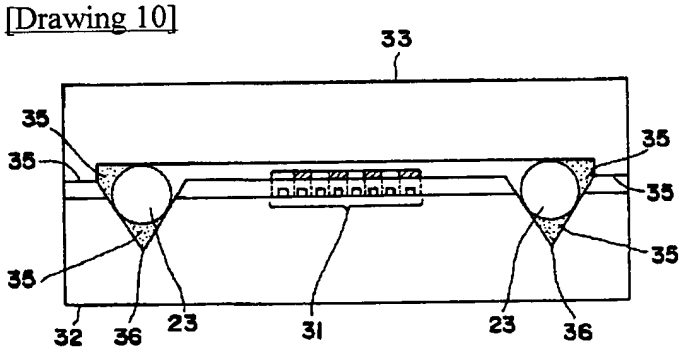
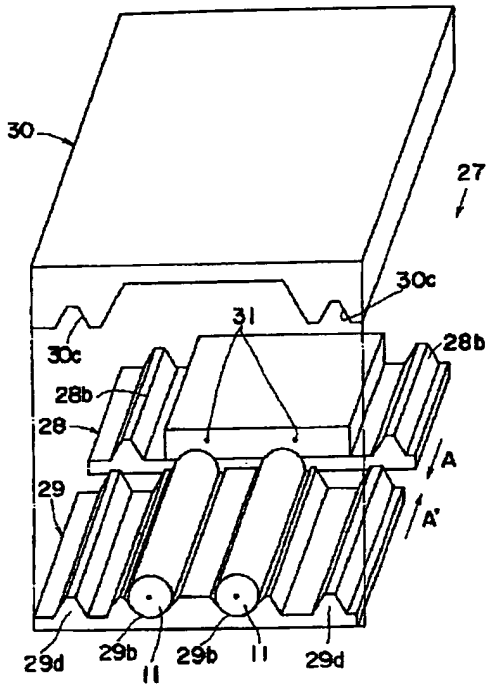


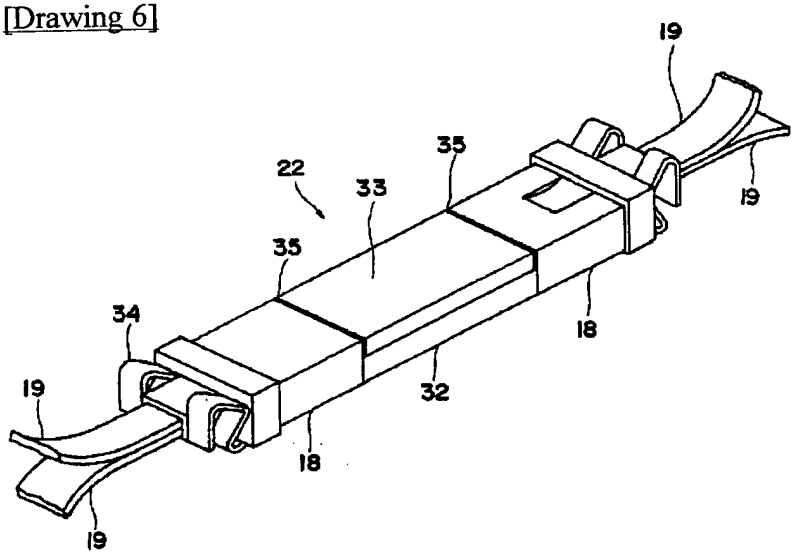
[Drawing 10]



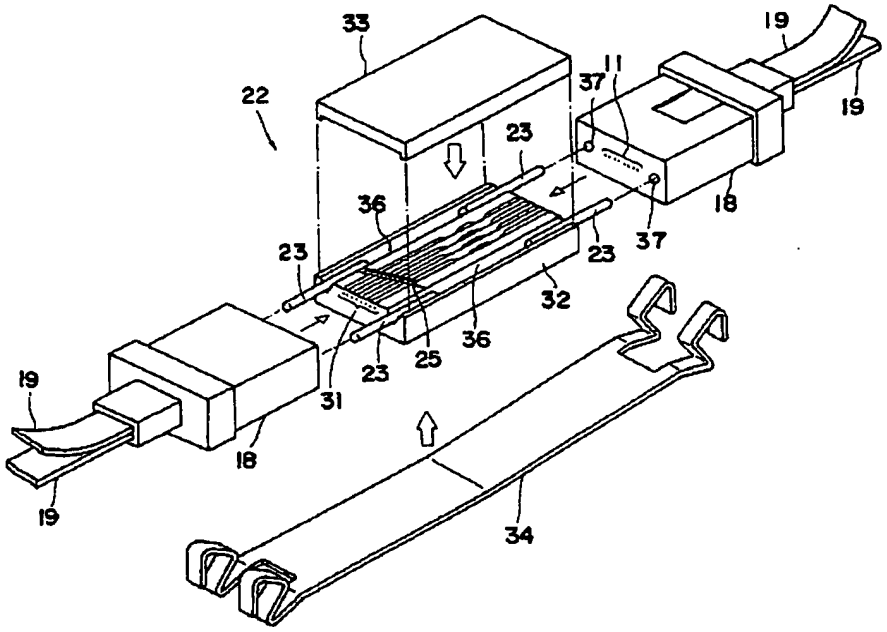
[Drawing 18]



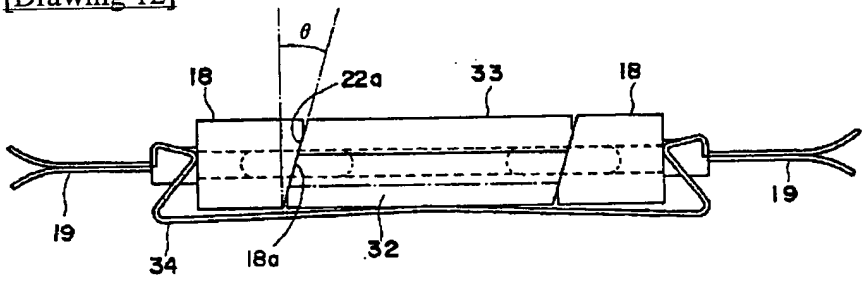
[Drawing 6]



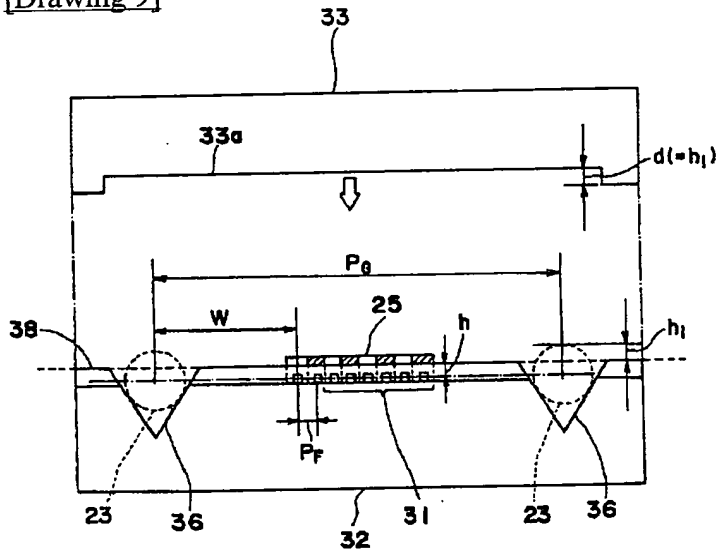
[Drawing 7]



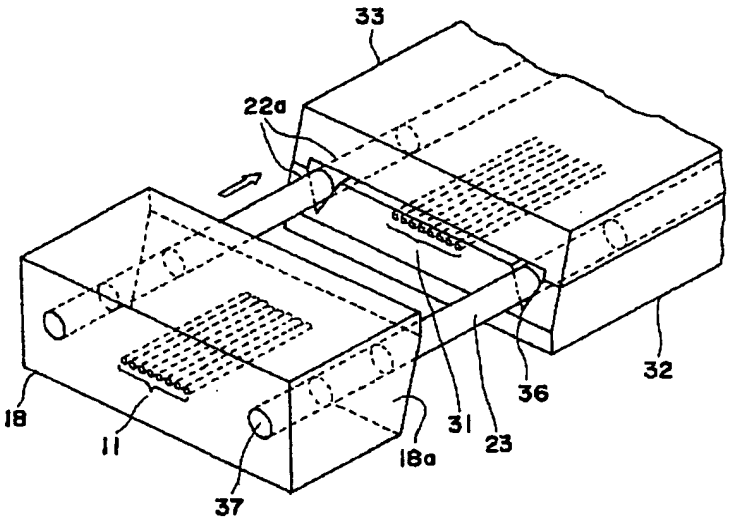
[Drawing 12]



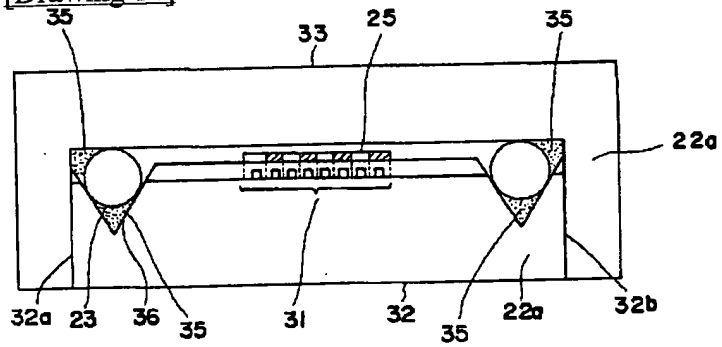
[Drawing 9]



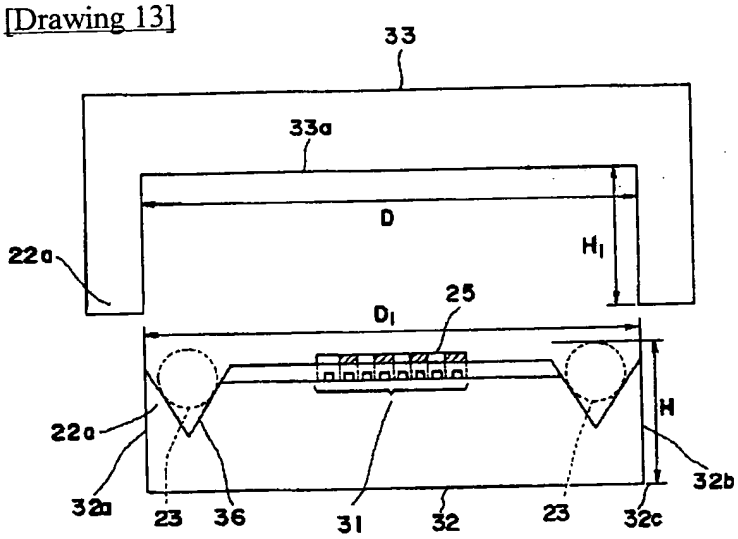
[Drawing 11]



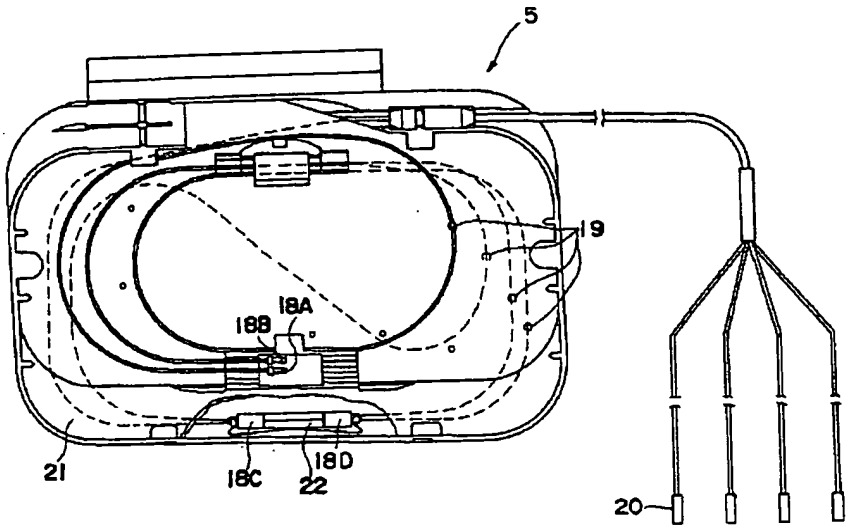
[Drawing 14]



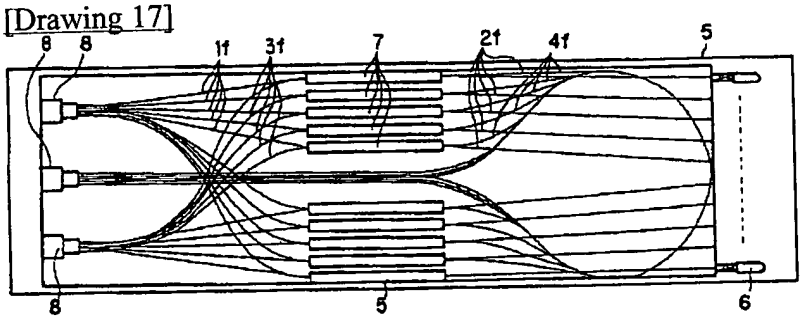
[Drawing 13]



[Drawing 15]

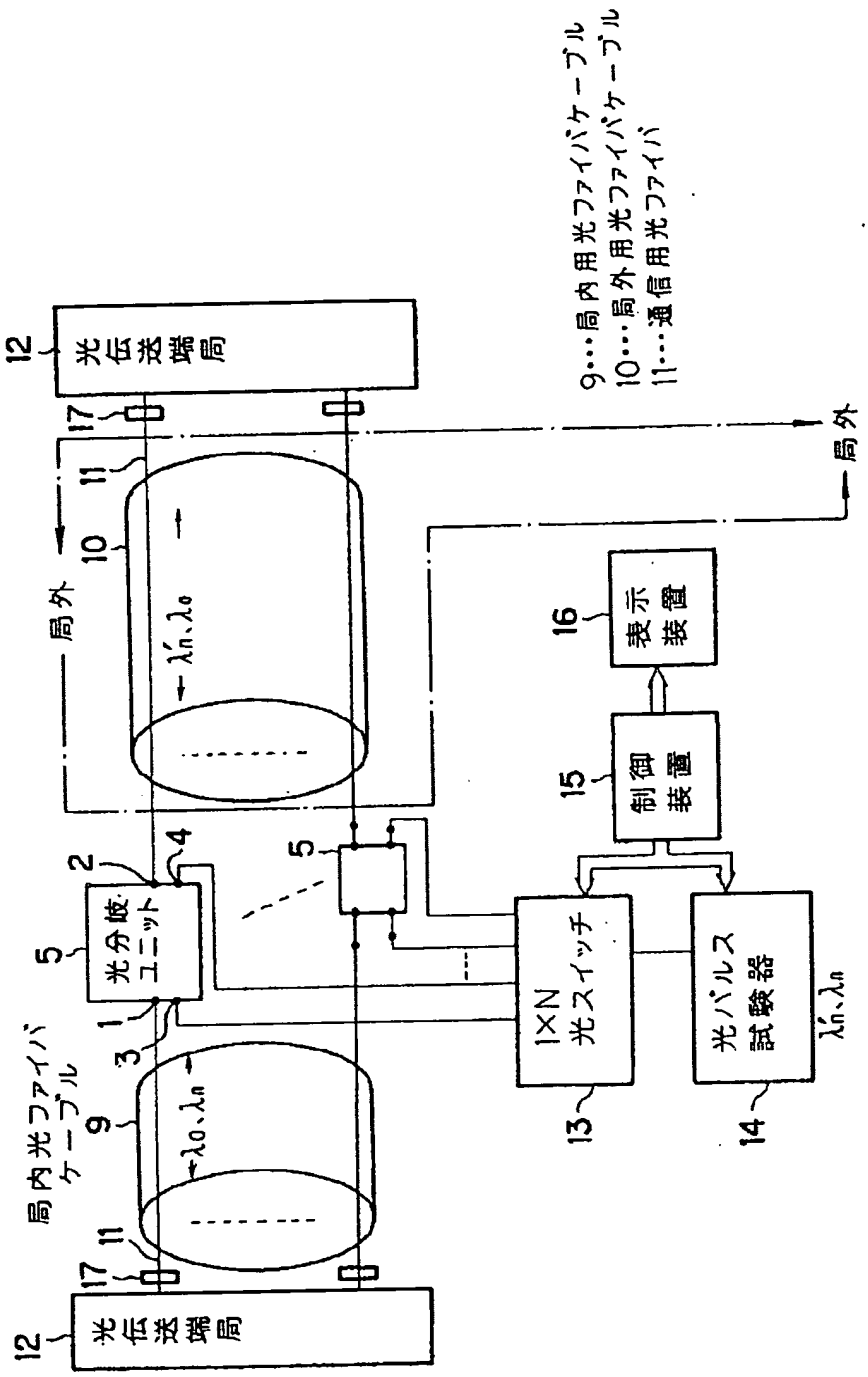


[Drawing 17]



1f…通信用ポート1の光ファイバ
2f…通信用ポート2の光ファイバ
3f…光挿入用ポート3の光ファイバ
4f…光分岐用ポート4の光ファイバ
5…光分岐ユニット
6…単心フェルール
7…光カプラユニット
8…多心フェルール

[Drawing 16]



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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing the 1st example of this invention.
[Drawing 2] It is the block diagram showing the completion of joint of drawing 1 .
[Drawing 3] It is the block diagram showing the 2nd example of this invention.
[Drawing 4] It is the block diagram showing the 3rd example of this invention.
[Drawing 5] It is the perspective view showing the 3rd filter base plate and optical filter in an example of this invention.
[Drawing 6] It is the assembly perspective view showing the 4th example of this invention.
[Drawing 7] It is the decomposition perspective view of drawing 6 .
[Drawing 8] some multi-core connector modules 18C and 18D -- it is a fracture perspective view.
[Drawing 9] It is the end view showing the relation between an optical waveguide substrate and a guide pin holddown member.
[Drawing 10] It is drawing showing the fitting condition of an optical waveguide substrate and a guide pin holddown member.
[Drawing 11] It is the assembly perspective view showing the 5th example of this invention.
[Drawing 12] It is drawing showing the junction condition of optical waveguide and an optical fiber.
[Drawing 13] It is the end view showing the 6th example of this invention.
[Drawing 14] It is drawing showing the fitting condition of an optical waveguide substrate and a guide pin holddown member.
[Drawing 15] It is the prototype block diagram showing the 7th example of this invention.
[Drawing 16] It is a beam-of-light way trial structure-of-a-system Fig.
[Drawing 17] It is the block diagram showing the conventional optical branching unit.
[Drawing 18] It is the assembly perspective view showing junction to the conventional optical waveguide and an optical fiber.
[Description of Notations]
1 Two Communication link port
3 Four Trial port
5 Optical Branching Unit
6 Single Alignment Ferrule
7 Optical Coupler Unit
8 Multi-core Ferrule
9 Office Cable
10 Outside Cable

11 Optical Fiber
12 Optical Transmission Terminal Office
13 1XN Optical Switch
14 Light Pulse Tester
15 Control Unit
16 Display
17 Optical Filter
18 Multi-core Photoconnector
19 Tape Core Wire
20 Single Alignment Connector
21 Extra Length Tray
22 Waveguide Type Light Coupler Module
23 Guide Pin
24 Hole for Optical Filter Insertion
25 Filter Base Plate
26 Filter Base Plate Insertion Slot
27 Optical Waveguide Components
28 Optical Waveguide Substrate
29 Optical Fiber Alignment Substrate
30 Fixed Substrate
31 Optical Waveguide
32 Optical Waveguide Substrate
33 Guide Pin Holddown Member
34 Clip
35 Adhesives
36 Guide Slot
37 Guide Pin Hole
38 Datum Level

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention is used for the optical line access equipment in the optical-communication field, adds an optical insertion branching function to a beam-of-light way, and relates to the waveguide type light coupler module used for the optical branching unit which made a trial or monitor of a circuit possible, and this unit.
[0002]
[Description of the Prior Art] Being in a beam-of-light way trial system, the thing of the former (JP,2-1632,A) makes the optical branching unit 5 intervene between the optical fibers 11 for a communication link which they are between the fiber optic cable 9 for offices, and the fiber optic cable 10 for the outsides, as shown in drawing 16 , equips this optical branching unit 5 with the communication link ports 1 and 2 and the trial ports 3 and 4, and is performing optical insertion and optical branching in these trial ports 3 and 4. The 1xN optical switch 13 for trial core-wire selection is connected to the trial ports 3 and 4, and it has the light pulse tester 14 which measures loss, the fault point, etc. of an optical fiber 11 further, the control unit 15, and the display 16 of a test result. Moreover, the optical filter 17 for trial light removal is arranged at the optical fiber 11 by the side of the optical transmission terminal office 12.
[0003] If it is in this system, in a trial, first, blank test core wire is chosen among N books with the 1xN optical switch 13, and the trial port 3 of the optical branching unit 5 in the selected core wire is chosen. And the trial light of the light pulse tester 14 is inserted in the fiber optic cable 10 for the outsides through the optical branching unit 5, and can measure loss, the fault point location, etc. of the optical fiber 11 for a communication link by receiving the level of the back scattered light.
[0004] The fiber optic cables 9 and 10 shown by this drawing 16 have held the optical fiber of dozens of or more alignments, as for the outside cable 10, a multi-core form optical fiber is used, and, as for the office cable 9, the single alignment type optical fiber is used, respectively. It will usually be called MDF (the main wiring rack) to carry out termination of the outside cable 10, and to connect with an office cable 9, and an optical branching unit will be held into this MDF.
[0005] Drawing 17 is what showed an example (JP,2-258408,U) of the conventional optical branching unit. The optical fibers 1f and 2f of the port for a communication link corresponding to the communication link ports 1 and 2 and the trial ports 3 and 4 of the optical branching unit 5 which are shown in drawing 16 , 3f of optical fibers of the port 3 for optical insertion, and 4f of optical fibers of the port 4 for optical branching are connected to the optical coupler unit 7 according to an individual, respectively. While 2f of optical fibers is connected to the single alignment ferrule 6, respectively, optical fibers 1f and 3f etc. show the optical branching unit 5

connected to the multi-core ferrule 8.
[0006] Drawing 18 shows an example (JP,4-340507,A) of the optical waveguide components in connection between the conventional optical fiber and optical waveguide. As shown in this drawing, as for the optical waveguide components 27, optical waveguide 31 is formed on the optical waveguide substrate 28 with which optical waveguide 31 was formed and guide 28b for positioning was formed. On the other hand, compare with this optical waveguide substrate 28, and it is contacted and the optical fiber alignment substrate 29 with which guide 29d for carrying out positioning with optical fiber alignment slot 29b which positions the optical fiber 11 which should be joined to optical waveguide 31, and said optical waveguide substrate 28 was formed is used. Optical waveguide components are constituted using the fixed substrate 30 with which guide carrier 30c which it fits in [c] with each guides 28b and 29d of said optical waveguide substrate 28 and the optical fiber alignment substrate 29, and adjusts said optical waveguide 31 and optical fiber 11 was formed.
[0007]
[Problem(s) to be Solved by the Invention] by the way, in the optical branching unit since each above-mentioned **, each optical coupler which constitutes 2 sets of optical coupler units 7 from drawing 17 is a several mm cylindrical shape member in practice, and since the branching unit of further multi-core is formed not only in four alignments or eight alignments but in recently like drawing 17 , equipment is becoming large-sized. Moreover, since optical fibers 1f, 2f, 3f, and 4f are connected to each optical coupler according to an individual, there are many production processes, and such a very troublesome process is needed that it becomes multi-core.
[0008] Moreover, in connection with the conventional optical fiber and optical waveguide which were shown in drawing 18 , if the optical waveguide 31 of the optical waveguide substrate 28 is not contacted at the same time it holds an optical fiber 11 in optical fiber alignment slot 29b of the optical fiber alignment substrate 29, there is a problem that immobilization is impossible with the fixed substrate 30. And there is a possibility that an optical fiber 11 may shift in the die-length direction delicately, in that case. Furthermore, there is a problem that attachment by the optical fiber alignment substrate 29 becomes difficulty, so that an optical fiber 11 becomes multi-core.
[0009] This invention aims at offering the waveguide type light coupler module used for the optical branching unit which simplified connection of an optical fiber, and this optical branching unit while it miniaturizes an optical coupler and summarizes extra length processing small in view of said problem.
[0010]
[Means for Solving the Problem] The configuration of the optical branching unit concerning this invention which attains the above-mentioned purpose When performing a beam-of-light way trial, it can connect with the multi-core connector module of two 2-N alignment hold in the optical branching unit used for the optical line access equipment for inserting trial light in a beam-of-light way. N alignment hold form multi-core connector which hits one communication link port while it has the chip-ized waveguide form light coupler module which carried out N individual accumulation, It has 2-N alignment hold form multi-core connector which hits two trial ports, and N alignment multi-core connector which hits the communication link port of another side corresponding to above-mentioned one communication link port. While held N alignment corresponding to one trial port by turns with tape core wire among the above-mentioned N alignment hold form multi-core connector and the above-mentioned 2-N alignment hold form multi-core connector, and it connects with the multi-core connector module of the above-mentioned 2-N alignment hold. It is based on having connected the remaining N alignment corresponding to the trial port of another side to the multi-core connector module of

the above-mentioned 2-N alignment hold of another side held by turns with tape core wire among the above-mentioned N ****** optical connecter and the above-mentioned 2-N alignment hold form multi-core connector.
[0011] Moreover, the configuration of the waveguide type light coupler module used for the optical branching unit concerning this invention SiO2 formed on the silicon substrate The optical waveguide substrate which has the guide slot for positioning of at least two or more which has a predetermined distance and was formed in parallel from the optical waveguide and this optical waveguide which were formed corresponding to two or more optical fibers which have and install predetermined spacing on a layer, The guide pin holddown member which have [holddown member] the guide pin which fits into said guide slot, and these two or more guide pins make said guide Mizouchi project [holddown member] from the both-ends side of an optical waveguide substrate, and carries out adhesion immobilization, It is characterized by having a clip holding the optical coupling condition of the multi-core photoconnector which holds the optical fiber by which the position arrangement was carried out to comparing and carrying out optical coupling to said optical waveguide when said guide pin fits into said guide slot, and said optical waveguide and multi-core photoconnector.
[0012] The height of the each shaft center of optical waveguide and each shaft center of a guide pin in the both-ends side of an optical waveguide substrate is in agreement, and you may make it arrange on the same straight line in said waveguide type light coupler module.
[0013] You may make it prepare space between the up datum level of optical waveguide, and a guide pin holddown member in the optical waveguide substrate of said waveguide type light coupler module.
[0014] You may make it grind aslant the end face of an optical fiber, and the optical ON outgoing radiation end face of optical waveguide at the respectively equal include angle theta in the optical waveguide substrate of said waveguide type light coupler module.
[0015] On the communication line of a waveguide type light coupler module, it may be made to mount the optical filter for trial light removal.
[0016]
[Function] Moreover, a miniaturization and extra length processing of an optical coupler could be simplified by tying with tape core wire between connectors by having the chip-ized optical coupler module and connecting with a connector, without using the conventional ****** coupler unit, and the production process also became very easy by integration and tape-ization.
[0017] Said waveguide type light coupler module fits in and positions a guide pin into the guide slot for positioning formed in the optical waveguide substrate, and makes this guide pin project from the both-ends side of the optical waveguide substrate concerned, and carries out adhesion immobilization by the guide pin holddown member. Subsequently, fitting is carried out with this guide pin in which this optical waveguide substrate and multi-core photoconnector were formed by this optical waveguide substrate. The optical waveguide by which this guide pin was prepared in the optical waveguide substrate in the condition of having fitted into the optical waveguide substrate and the multi-core photoconnector, and the multi-core photoconnector held at the multi-core photoconnector are adjusted, and an optical coupling condition is held with a clip. It enables this to join multi-core optical waveguide and optical fiber by no aligning.
[0018]
[Example] Hereafter, the example of this invention is explained with reference to drawing 1 - drawing 15 .
[0019] It explains referring to the example of point ** and the optical branching unit of this invention about drawing 1 - drawing 5 .
[0020] [Example 1] The multi-core connector of 4 alignment hold to which drawing 1 is the

optical branching unit of the 1st example, and 18A hits a communication link port, The multi-core connector of 8 alignment hold to which 18B hits a trial port, the multi-core connector module of 8 alignment hold connected to the waveguide type light coupler module 22 with which 18C and 18D allotted the optical coupler unit 7, It is a pin for connection for the single alignment connector to which 19 hits 4 alignment tape core wire, and 20 hits a communication link port, and 21 to align an extra length tray, and for 23 align the optical coupler module 22 and the multi-core connector modules 18C and 18D. In here, the waveguide type light coupler module 22 is the chip by which four alignments were integrated, and can connect now the multi-core connector modules 18C and 18D to this module 22.

[0021] Drawing 2 shows drawing which connected the optical coupler module 22 and the connector modules 18C and 18D which are shown in drawing 1 , and the optical branching unit 5 completed as a whole.

[0022] [Example 2] Drawing 3 is the optical branching unit of the 2nd example, and it gives an include angle suitably so that the optical filter 17 for trial light removal may be inserted into the communication line of the waveguide type light coupler module 22 and the difference with drawing 1 may moreover prevent reflection to the communication line. And the hole 24 for insertion of this optical filter 17 is made by etching etc. Simplification and economization of a system can be attained by existence of this filter 17.

[0023] [Example 3] Drawing 4 is the optical branching unit of the 3rd example, and the filter base plate 25 with which the waveguide type light coupler module 22 is equipped is equipped with an optical filter 17 according to the array of the communication line. And in order to prevent reflection to the communication line like the case of drawing 3 , it is inserted in the slot 26 which gave the suitable include angle, and is fixed with adhesives. the filter base plate 25 and a filter 17 are shown in drawing 5 (a) and (b) -- as -- the shape of a ****** rectangle -- or it may be constituted so that it may become a bridge beam configuration. In this case, as compared with the structure shown in drawing 3 , it was not based on etching, but the usual cutting was completed, and creation of the waveguide type light coupler module 22 became easy.

[0024] In the optical branching unit mentioned above, although the explanation about the interior of an optical coupler module is omitted, it is not limited to the example shown below that optical branching is just performed as this optical coupler, but various structures can be considered.

[0025] Next, it explains, using for the optical branching unit of this invention, and referring to drawing 6 - drawing 15 about the example of a suitable waveguide type light coupler module.

[0026] [Example 4] Drawing 6 is the 4th example of this invention, and the waveguide type light coupler module 22 is constituted by the optical waveguide substrate 32, the guide pin holddown member 33, the multi-core photoconnector (8MT) 18, the clip 34, and the guide pin 23, and is drawing having shown the junction condition of optical waveguide and an optical fiber.

[0027] Drawing 7 is the exploded view of drawing 6 , where optical waveguide 31 and the guide slot 36 for positioning were established in the optical waveguide substrate 32, and it fitted in and positioned the guide pin 23 to it in this guide slot 36 and some guide pins 23 are made to project from the both-ends side of the optical waveguide substrate 32, adhesion immobilization is carried out by the guide pin holddown member 33 with adhesives 35, and this guide pin 23 is held at the optical waveguide substrate 32. The multi-core photoconnector (8MT) 18 holds the optical fiber 11 by which the position arrangement was carried out to comparing and carrying out optical coupling to said optical waveguide 31, when said guide pin 23 fits into said guide slot 36, and it becomes joinable by being compared in the guide pin hole 37 of this multi-core photoconnector (8MT) 18. A clip 34 holds the optical coupling condition of said optical waveguide 31 and multi-core photoconnector (8MT) 18.

[0028] The multi-core photoconnector (8MT) 18 shown in drawing 7 is a fracture perspective

view a part, and drawing 8 inserts in the ferrule of a multi-core photoconnector two 4 alignment tape core wire 19 which hits a communication link port and a trial port. Each core wire of two 4 alignment tape core wire 19 and 19 is connected with the waveguide type light coupler module 22 which is held by turns and counters here.

[0029] It is SiO2 by which drawing 9 is the end view showing the relative-position relation between optical waveguide 31 and a guide pin 23, and the optical waveguide substrate 32 was formed on the silicon substrate. The guide slot 36 for positioning of at least two or more which has the predetermined distance W and was formed in parallel from the optical waveguide 31 and this optical waveguide 31 which were formed corresponding to two or more optical fibers 11 which have and install predetermined spacing on a layer is formed. Moreover, the guide pin holddown member 33 fixes the guide pin 23 which fits into said guide slot 36, and after these two or more guide pins 23 have made it project from the both-ends side of said guide slot 36 intrinsic-light waveguide substrate 32, it is carrying out adhesion immobilization.

[0030] As for the optical waveguide 31 formed in the optical waveguide substrate 32 in the end face of the optical waveguide substrate 32, eight optical waveguides 31 are formed by two or more, for example, this example. the location of depth h predetermined [the datum level / shaft center / each / 38 on the basis of the top face of the optical waveguide substrate 32 as such optical waveguides 31 are shown in drawing 9 to] -- and spacing PF predetermined in each shaft center distance It is prepared side by side. The guide slot 36 for positioning in moreover, the location of the predetermined distance W from the shaft center of the optical waveguide 31 of both ends And it is set up and formed so that the depth of the shaft center of a guide pin 23 may be in agreement with the depth of said optical waveguide 31. Each spacing PF of two or more optical fibers 11 which the guide pin 23 connected behind and the multi-core photoconnector (8MT) 18 which has the guide pin hole 37 which fits in hold And spacing PG of the guide pin hole 37 A relative position is made to agree, respectively and it is arranged on the same straight line.

[0031] On the other hand, the optical waveguide substrate 32 and inferior-surface-of-tongue 33a which counters form the crevice, and the guide pin holddown member 33 is the height h1 of the top-most vertices of a guide pin 23 from the datum level 38 of depth d and the optical waveguide substrate 32. It is set up equally (d=h1). And a guide pin 23 is pinched by the peripheral surface of the guide slot 36 of the optical waveguide substrate 32, and inferior-surface-of-tongue 33a of the guide pin holddown member 33, and is fixed. And the both-ends side of the optical waveguide substrate 32, each both-ends side of optical waveguide 31, and the both-ends side of the guide pin holddown member 33 are made flat-tapped, respectively.

[0032] The guide pin 23 in drawing 9 is pinched into the guide slot 36, adhesion immobilization is carried out, only the inside of the space in the space by the side of the inferior surface of tongue of the guide pin 23 of the guide slot 36 and by the side of the contact to the guide pin holddown member 33 and the optical waveguide substrate 32 is filled up with adhesives 35, and is carrying out adhesion immobilization, and since drawing 10 does not affect optical waveguide 31, it avoids restoration of adhesives 35, and it forms space between the up datum level 38 of optical waveguide 31, and the guide pin holddown member 33.

[0033] The optical waveguide substrate 32 and guide pin holddown-member 33 grade can carry out V groove formation of the guide slot 36 grade for positioning with the anisotropic etching technique of silicon, using single crystal silicon as a substrate ingredient. Moreover, on a silicon substrate, the quartz waveguide by the fire depositing method which can be constituted can be used easily, and it is formed with high precision.

[0034] The optical waveguide 31 of the optical waveguide substrate 32 and the optical fiber 11 of a multi-core photoconnector (8MT) 18 which were shown in drawing 10 have consistency

correctly with a guide pin 23, and each adjustment end-face comrade is contacted. Thereby, optical waveguide 31 and an optical fiber 11 are correctly joined by no aligning.
[0035] [Example 5] Drawing 11 is the 5th example of this invention, the perspective view of the joint of the waveguide type light coupler module 22 is shown, and drawing 12 is drawing showing the side elevation of the waveguide type light coupler module 22.
[0036] The same sign is attached about the parts of a thing and coincidence explained in drawing 6 of said 4th example - drawing 10 in drawing 11 and drawing 12 , and explanation of an equivalent part is omitted.
[0037] As the waveguide type light coupler module concerning the 5th example is shown in drawing 11 and 12, in case optical waveguide 31 and the optical fiber 11 of a multi-core photoconnector (8MT) 18 are adjusted with a guide pin 23, end-face 18a of the multi-core photoconnector 18 which the optical fiber 11 of the multi-core photoconnector (8MT) 18 contacted exposes, and optical ON outgoing radiation end-face 22a of optical waveguide 31 are aslant ground at the respectively equal include angle theta. The 5th example is for reducing the reflective return light by the Fresnel reflection produced in a part for the joint of the optical waveguide 31 of said 4th example, and the optical fiber 11 of a multi-core photoconnector (8MT) 18. For example, it prevents the reflected light by Fresnel reflection becoming trapped mode by performing highly precise angle lapping at the include angle theta of about 8 times or more about end-face 18a of the multi-core photoconnector 18 which 11 of an optical fiber exposes, and optical ON outgoing radiation end-face 22a of optical waveguide 31, and reduction of connection loss of the propagation light by Fresnel reflection can be aimed at.
[0038] [Example 6] Drawing 13 is the 6th example of this invention, the end view showing the relation between the optical waveguide substrate 32 and the guide pin holddown member 33 is shown, and drawing 14 is drawing showing the fitting condition of drawing 13 .
[0039] The cross-section configuration is formed in a reverse concave so that the guide pin holddown member 33 may enclose the top face and both-sides side of the optical waveguide substrate 32, as shown in drawing 13 and 14, and the waveguide type light coupler module concerning the 6th example is pinched for a guide pin 23 like said 4th example.
[0040] Since the limit is added to the magnitude of optical ON outgoing radiation end-face 22a in the 6th example as shown in drawing 13 , the both-sides sides 32a and 32b of the optical waveguide substrate 32 have been deleted to this side of the guide slot 36, and it is the width of face D1 between 32b from side-face 32a. Inferior-surface-of-tongue 33a of the guide pin holddown member 33 is set up equally (D=D1) so that it may oppose. Moreover, the depth H1 by which inferior-surface-of-tongue 33a which opposes the optical waveguide substrate 32 was used as the concave streak Height H of the top-most vertices of a guide pin 23 is set up equally (H=H1) from inferior-surface-of-tongue 32c of the optical waveguide substrate 32. A guide pin 23 is pinched by the peripheral surface of the guide slot 36 of the optical waveguide substrate 32, and inferior-surface-of-tongue 33a of the guide pin holddown member 33, and adhesion immobilization is carried out with adhesives 35 in the both-sides sides 32a and 32b of the optical waveguide substrate 32.
[0041] The 6th example can perform immobilization of the guide pin 23 which has reinforcement more in immobilization of the guide pin 23 of said 4th example. Moreover, also in adhesion with the optical waveguide substrate 32 and the guide pin holddown member 33, there is outstanding effectiveness from which reinforcement adhesion immobilization is attained and the desorption to the guide slot 36 of a guide pin 23 also becomes possible.
[0042] [Example 7] Drawing 15 is the 7th example and is drawing showing the prototype configuration of the optical branching unit of this invention.
[0043] The 7th example made the optical branching unit as an experiment, as shown in drawing

15 , and it was able to attain simplification of an optical branching unit. As shown in this drawing, the extra length processing section is expressed with the wavy line, and a thing without the complexity by tape-izing is checked. Moreover, by standing the waveguide type light coupler module 22 sideways, and mounting it in a unit, there is neither torsion in the extra length processing section of the tape core wire 19 nor a strain, and attachment of the tape core wire 19 can be performed.

[0044] The measurement result of a prototype is shown in "Table 1." It is the result of carrying out about the waveguide type light coupler module 22 in this prototype using a straight-line waveguide type light module.

[0045]

[Table 1]

測定結果一覧表

心線 No.		#1	#2	#3	#4	#5	#6	#7	#8
接続損失(dB)		0.69	0.87	0.72	0.77	0.61	0.60	0.57	0.8(
反射減衰量(dB)		49	46	52	47	51	47	52	47
温度サイクル特性	MAX値(dB)	0.16	0.13	0.10	0.15	0.07	0.04	0.05	0.0(
	MIN値(dB)	-0.14	-0.05	-0.07	-0.16	-0.03	-0.02	-0.04	-0.0
	変動量(dB)	0.30	0.18	0.17	0.31	0.10	0.06	0.09	0.0
偏光Loss特性(dB)		0.09	0.11	0.14	0.12	0.10	0.05	0.10	0.07

[0046] Although the above 4th - the 6th example showed the case of the guide pin method which formed the guide slot 36 for positioning in one to the optical waveguide substrate 32, this invention may not be restricted to this, and may form other configurations, optical waveguide, and the guide slot for positioning in each **, for example, may fix them correctly by position relation, respectively. Moreover, although the case where eight optical waveguides 31 were formed in the above-mentioned example was shown, this invention is not restricted to this, and even if it uses the case where many optical waveguides and optical fibers are joined, the effectiveness of this invention can be acquired. Moreover, various structures can be considered that optical branching is just performed as this optical coupler.

[0047]

[Effect of the Invention] Since simplification of a configuration and simplification of assembly can be attained by attaining formation of an integration chip, and tape-ization in this invention as explained above, a small and economical thing is obtained in the optical access part in a beam-of-light way. Moreover, according to the waveguide type light coupler module of this invention, optical waveguide and an optical fiber were not aligned, and it becomes possible to carry out optical coupling very easily, it becomes possible to make connection between optical waveguide and an optical fiber by multi-core package, working capacity improves sharply, and reduction of cost is achieved. Moreover, there is outstanding effectiveness that it is simple for the configuration of each part article for the desorption of optical waveguide and an optical fiber to

become possible, and for changing of an optical waveguide chip etc. to be performed easily, and for transmission loss of a connection to be made small etc., for connection with a guide pin and a clip.

[Translation done.]

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TECHNICAL FIELD

[Industrial Application] This invention is used for the optical line access equipment in the optical-communication field, adds an optical insertion branching function to a beam-of-light way, and relates to the waveguide type light coupler module used for the optical branching unit which made a trial or monitor of a circuit possible, and this unit.

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PRIOR ART

[Description of the Prior Art] Being in a beam-of-light way trial system, the thing of the former (JP,2-1632,A) makes the optical branching unit 5 intervene between the optical fibers 11 for a communication link which they are between the fiber optic cable 9 for offices, and the fiber optic cable 10 for the outsides, as shown in drawing 16 , equips this optical branching unit 5 with the communication link ports 1 and 2 and the trial ports 3 and 4, and is performing optical insertion and optical branching in these trial ports 3 and 4. The 1xN optical switch 13 for trial core-wire selection is connected to the trial ports 3 and 4, and it has the light pulse tester 14 which measures loss, the fault point, etc. of an optical fiber 11 further, the control unit 15, and the display 16 of a test result. Moreover, the optical filter 17 for trial light removal is arranged at the optical fiber 11 by the side of the optical transmission terminal office 12.
[0003] If it is in this system, in a trial, first, blank test core wire is chosen among N books with the 1xN optical switch 13, and the trial port 3 of the optical branching unit 5 in the selected core wire is chosen. And the trial light of the light pulse tester 14 is inserted in the fiber optic cable 10 for the outsides through the optical branching unit 5, and can measure loss, the fault point location, etc. of the optical fiber 11 for a communication link by receiving the level of the back scattered light.
[0004] The fiber optic cables 9 and 10 shown by this drawing 16 have held the optical fiber of dozens of or more alignments, as for the outside cable 10, a multi-core form optical fiber is used, and, as for the office cable 9, the single alignment type optical fiber is used, respectively. It will usually be called MDF (the main wiring rack) to carry out termination of the outside cable 10, and to connect with an office cable 9, and an optical branching unit will be held into this MDF.
[0005] Drawing 17 is what showed an example (JP,2-258408,U) of the conventional optical branching unit. The optical fibers 1f and 2f of the port for a communication link corresponding to the communication link ports 1 and 2 and the trial ports 3 and 4 of the optical branching unit 5 which are shown in drawing 16 , 3f of optical fibers of the port 3 for optical insertion, and 4f of optical fibers of the port 4 for optical branching are connected to the optical coupler unit 7 according to an individual, respectively. While 2f of optical fibers is connected to the single alignment ferrule 6, respectively, optical fibers 1f and 3f etc. show the optical branching unit 5 connected to the multi-core ferrule 8.
[0006] Drawing 18 shows an example (JP,4-340507,A) of the optical waveguide components in connection between the conventional optical fiber and optical waveguide. As shown in this drawing, as for the optical waveguide components 27, optical waveguide 31 is formed on the optical waveguide substrate 28 with which optical waveguide 31 was formed and guide 28b for positioning was formed. On the other hand, compare with this optical waveguide substrate 28, and it is contacted and the optical fiber alignment substrate 29 with which guide 29d for carrying

out positioning with optical fiber alignment slot 29b which positions the optical fiber 11 which should be joined to optical waveguide 31, and said optical waveguide substrate 28 was formed is used. Optical waveguide components are constituted using the fixed substrate 30 with which guide carrier 30c which it fits in [c] with each guides 28b and 29d of said optical waveguide substrate 28 and the optical fiber alignment substrate 29, and adjusts said optical waveguide 31 and optical fiber 11 was formed.

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EFFECT OF THE INVENTION

[Effect of the Invention] Since simplification of a configuration and simplification of assembly can be attained by attaining formation of an integration chip, and tape-ization in this invention as explained above, a small and economical thing is obtained in the optical access part in a beam-of-light way. Moreover, according to the waveguide type light coupler module of this invention, optical waveguide and an optical fiber were not aligned, and it becomes possible to carry out optical coupling very easily, it becomes possible to make connection between optical waveguide and an optical fiber by multi-core package, working capacity improves sharply, and reduction of cost is achieved. Moreover, there is outstanding effectiveness that it is simple for the configuration of each part article for the desorption of optical waveguide and an optical fiber to become possible, and for changing of an optical waveguide chip etc. to be performed easily, and for transmission loss of a connection to be made small etc., for connection with a guide pin and a clip.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] by the way, in the optical branching unit since each above-mentioned **, each optical coupler which constitutes 2 sets of optical coupler units 7 from drawing 17 is a several mm cylindrical shape member in practice, and since the branching unit of further multi-core is formed not only in four alignments or eight alignments but in recently like drawing 17 , equipment is becoming large-sized. Moreover, since optical fibers 1f, 2f, 3f, and 4f are connected to each optical coupler according to an individual, there are many production processes, and such a very troublesome process is needed that it becomes multi-core.
[0008] Moreover, in connection with the conventional optical fiber and optical waveguide which were shown in drawing 18 , if the optical waveguide 31 of the optical waveguide substrate 28 is not contacted at the same time it holds an optical fiber 11 in optical fiber alignment slot 29b of the optical fiber alignment substrate 29, there is a problem that immobilization is impossible with the fixed substrate 30. And there is a possibility that an optical fiber 11 may shift in the die-length direction delicately, in that case. Furthermore, there is a problem that attachment by the optical fiber alignment substrate 29 becomes difficulty, so that an optical fiber 11 becomes multi-core.
[0009] This invention aims at offering the waveguide type light coupler module used for the optical branching unit which simplified connection of an optical fiber, and this optical branching unit while it miniaturizes an optical coupler and summarizes extra length processing small in view of said problem.

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MEANS

[Means for Solving the Problem] The configuration of the optical branching unit concerning this invention which attains the above-mentioned purpose When performing a beam-of-light way trial, it can connect with the multi-core connector module of two 2-N alignment hold in the optical branching unit used for the optical line access equipment for inserting trial light in a beam-of-light way. N alignment hold form multi-core connector which hits one communication link port while it has the chip-ized waveguide form light coupler module which carried out N individual accumulation, It has 2-N alignment hold form multi-core connector which hits two trial ports, and N alignment multi-core connector which hits the communication link port of another side corresponding to above-mentioned one communication link port. While held N alignment corresponding to one trial port by turns with tape core wire among the above-mentioned N alignment hold form multi-core connector and the above-mentioned 2-N alignment hold form multi-core connector, and it connects with the multi-core connector module of the above-mentioned 2-N alignment hold. It is based on having connected the remaining N alignment corresponding to the trial port of another side to the multi-core connector module of the above-mentioned 2-N alignment hold of another side held by turns with tape core wire among the above-mentioned N ****** optical connecter and the above-mentioned 2-N alignment hold form multi-core connector.
[0011] Moreover, the configuration of the waveguide type light coupler module used for the optical branching unit concerning this invention SiO2 formed on the silicon substrate The optical waveguide substrate which has the guide slot for positioning of at least two or more which has a predetermined distance and was formed in parallel from the optical waveguide and this optical waveguide which were formed corresponding to two or more optical fibers which have and install predetermined spacing on a layer, The guide pin holddown member which have [holddown member] the guide pin which fits into said guide slot, and these two or more guide pins make said guide Mizouchi project [holddown member] from the both-ends side of an optical waveguide substrate, and carries out adhesion immobilization, It is characterized by having a clip holding the optical coupling condition of the multi-core photoconnector which holds the optical fiber by which the position arrangement was carried out to comparing and carrying out optical coupling to said optical waveguide when said guide pin fits into said guide slot, and said optical waveguide and multi-core photoconnector.
[0012] The height of the each shaft center of optical waveguide and each shaft center of a guide pin in the both-ends side of an optical waveguide substrate is in agreement, and you may make it arrange on the same straight line in said waveguide type light coupler module.
[0013] You may make it prepare space between the up datum level of optical waveguide, and a guide pin holddown member in the optical waveguide substrate of said waveguide type light

coupler module.
[0014] You may make it grind aslant the end face of an optical fiber, and the optical ON outgoing radiation end face of optical waveguide at the respectively equal include angle theta in the optical waveguide substrate of said waveguide type light coupler module.
[0015] On the communication line of a waveguide type light coupler module, it may be made to mount the optical filter for trial light removal.

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OPERATION

[Function] Moreover, a miniaturization and extra length processing of an optical coupler could be simplified by tying with tape core wire between connectors by having the chip-ized optical coupler module and connecting with a connector, without using the conventional ****** coupler unit, and the production process also became very easy by integration and tape-ization.
[0017] Said waveguide type light coupler module fits in and positions a guide pin into the guide slot for positioning formed in the optical waveguide substrate, and makes this guide pin project from the both-ends side of the optical waveguide substrate concerned, and carries out adhesion immobilization by the guide pin holddown member. Subsequently, fitting is carried out with this guide pin in which this optical waveguide substrate and multi-core photoconnector were formed by this optical waveguide substrate. The optical waveguide by which this guide pin was prepared in the optical waveguide substrate in the condition of having fitted into the optical waveguide substrate and the multi-core photoconnector, and the multi-core photoconnector held at the multi-core photoconnector are adjusted, and an optical coupling condition is held with a clip. It enables this to join multi-core optical waveguide and optical fiber by no aligning.

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EXAMPLE

[Example] Hereafter, the example of this invention is explained with reference to drawing 1 - drawing 15 .
[0019] It explains referring to the example of point ** and the optical branching unit of this invention about drawing 1 - drawing 5 .
[0020] [Example 1] The multi-core connector of 4 alignment hold to which drawing 1 is the optical branching unit of the 1st example, and 18A hits a communication link port, The multi-core connector of 8 alignment hold to which 18B hits a trial port, the multi-core connector module of 8 alignment hold connected to the waveguide type light coupler module 22 with which 18C and 18D allotted the optical coupler unit 7, It is a pin for connection for the single alignment connector to which 19 hits 4 alignment tape core wire, and 20 hits a communication link port, and 21 to align an extra length tray, and for 23 align the optical coupler module 22 and the multi-core connector modules 18C and 18D. In here, the waveguide type light coupler module 22 is the chip by which four alignments were integrated, and can connect now the multi-core connector modules 18C and 18D to this module 22.
[0021] Drawing 2 shows drawing which connected the optical coupler module 22 and the connector modules 18C and 18D which are shown in drawing 1 , and the optical branching unit 5 completed as a whole.
[0022] [Example 2] Drawing 3 is the optical branching unit of the 2nd example, and it gives an include angle suitably so that the optical filter 17 for trial light removal may be inserted into the communication line of the waveguide type light coupler module 22 and the difference with drawing 1 may moreover prevent reflection to the communication line. And the hole 24 for insertion of this optical filter 17 is made by etching etc. Simplification and economization of a system can be attained by existence of this filter 17.
[0023] [Example 3] Drawing 4 is the optical branching unit of the 3rd example, and the filter base plate 25 with which the waveguide type light coupler module 22 is equipped is equipped with an optical filter 17 according to the array of the communication line. And in order to prevent reflection to the communication line like the case of drawing 3 , it is inserted in the slot 26 which gave the suitable include angle, and is fixed with adhesives. the filter base plate 25 and a filter 17 are shown in drawing 5 (a) and (b) -- as -- the shape of a ****** rectangle -- or it may be constituted so that it may become a bridge beam configuration. In this case, as compared with the structure shown in drawing 3 , it was not based on etching, but the usual cutting was completed, and creation of the waveguide type light coupler module 22 became easy.
[0024] In the optical branching unit mentioned above, although the explanation about the interior of an optical coupler module is omitted, it is not limited to the example shown below that optical branching is just performed as this optical coupler, but various structures can be considered.

[0025] Next, it explains, using for the optical branching unit of this invention, and referring to drawing 6 - drawing 15 about the example of a suitable waveguide type light coupler module.
[0026] [Example 4] Drawing 6 is the 4th example of this invention, and the waveguide type light coupler module 22 is constituted by the optical waveguide substrate 32, the guide pin holddown member 33, the multi-core photoconnector (8MT) 18, the clip 34, and the guide pin 23, and is drawing having shown the junction condition of optical waveguide and an optical fiber.
[0027] Drawing 7 is the exploded view of drawing 6 , where optical waveguide 31 and the guide slot 36 for positioning were established in the optical waveguide substrate 32, and it fitted in and positioned the guide pin 23 to it in this guide slot 36 and some guide pins 23 are made to project from the both-ends side of the optical waveguide substrate 32, adhesion immobilization is carried out by the guide pin holddown member 33 with adhesives 35, and this guide pin 23 is held at the optical waveguide substrate 32. The multi-core photoconnector (8MT) 18 holds the optical fiber 11 by which the position arrangement was carried out to comparing and carrying out optical coupling to said optical waveguide 31, when said guide pin 23 fits into said guide slot 36, and it becomes joinable by being compared in the guide pin hole 37 of this multi-core photoconnector (8MT) 18. A clip 34 holds the optical coupling condition of said optical waveguide 31 and multi-core photoconnector (8MT) 18.
[0028] The multi-core photoconnector (8MT) 18 shown in drawing 7 is a fracture perspective view a part, and drawing 8 inserts in the ferrule of a multi-core photoconnector two 4 alignment tape core wire 19 which hits a communication link port and a trial port. Each core wire of two 4 alignment tape core wire 19 and 19 is connected with the waveguide type light coupler module 22 which is held by turns and counters here.
[0029] It is SiO2 by which drawing 9 is the end view showing the relative-position relation between optical waveguide 31 and a guide pin 23, and the optical waveguide substrate 32 was formed on the silicon substrate. The guide slot 36 for positioning of at least two or more which has the predetermined distance W and was formed in parallel from the optical waveguide 31 and this optical waveguide 31 which were formed corresponding to two or more optical fibers 11 which have and install predetermined spacing on a layer is formed. Moreover, the guide pin holddown member 33 fixes the guide pin 23 which fits into said guide slot 36, and after these two or more guide pins 23 have made it project from the both-ends side of said guide slot 36 intrinsic-light waveguide substrate 32, it is carrying out adhesion immobilization.
[0030] As for the optical waveguide 31 formed in the optical waveguide substrate 32 in the end face of the optical waveguide substrate 32, eight optical waveguides 31 are formed by two or more, for example, this example. the location of depth h predetermined [the datum level / shaft center / each / 38 on the basis of the top face of the optical waveguide substrate 32 as such optical waveguides 31 are shown in drawing 9 to] -- and spacing PF predetermined in each shaft center distance It is prepared side by side. The guide slot 36 for positioning in moreover, the location of the predetermined distance W from the shaft center of the optical waveguide 31 of both ends And it is set up and formed so that the depth of the shaft center of a guide pin 23 may be in agreement with the depth of said optical waveguide 31. Each spacing PF of two or more optical fibers 11 which the guide pin 23 connected behind and the multi-core photoconnector (8MT) 18 which has the guide pin hole 37 which fits in hold And spacing PG of the guide pin hole 37 A relative position is made to agree, respectively and it is arranged on the same straight line.
[0031] On the other hand, the optical waveguide substrate 32 and inferior-surface-of-tongue 33a which counters form the crevice, and the guide pin holddown member 33 is the height h1 of the top-most vertices of a guide pin 23 from the datum level 38 of depth d and the optical waveguide substrate 32. It is set up equally (d=h1). And a guide pin 23 is pinched by the peripheral surface

of the guide slot 36 of the optical waveguide substrate 32, and inferior-surface-of-tongue 33a of the guide pin holddown member 33, and is fixed. And the both-ends side of the optical waveguide substrate 32, each both-ends side of optical waveguide 31, and the both-ends side of the guide pin holddown member 33 are made flat-tapped, respectively.
[0032] The guide pin 23 in drawing 9 is pinched into the guide slot 36, adhesion immobilization is carried out, only the inside of the space in the space by the side of the inferior surface of tongue of the guide pin 23 of the guide slot 36 and by the side of the contact to the guide pin holddown member 33 and the optical waveguide substrate 32 is filled up with adhesives 35, and is carrying out adhesion immobilization, and since drawing 10 does not affect optical waveguide 31, it avoids restoration of adhesives 35, and it forms space between the up datum level 38 of optical waveguide 31, and the guide pin holddown member 33.
[0033] The optical waveguide substrate 32 and guide pin holddown-member 33 grade can carry out V groove formation of the guide slot 36 grade for positioning with the anisotropic etching technique of silicon, using single crystal silicon as a substrate ingredient. Moreover, on a silicon substrate, the quartz waveguide by the fire depositing method which can be constituted can be used easily, and it is formed with high precision.
[0034] The optical waveguide 31 of the optical waveguide substrate 32 and the optical fiber 11 of a multi-core photoconnector (8MT) 18 which were shown in drawing 10 have consistency correctly with a guide pin 23, and each adjustment end-face comrade is contacted. Thereby, optical waveguide 31 and an optical fiber 11 are correctly joined by no aligning.
[0035] [Example 5] Drawing 11 is the 5th example of this invention, the perspective view of the joint of the waveguide type light coupler module 22 is shown, and drawing 12 is drawing showing the side elevation of the waveguide type light coupler module 22.
[0036] The same sign is attached about the parts of a thing and coincidence explained in drawing 6 of said 4th example - drawing 10 in drawing 11 and drawing 12 , and explanation of an equivalent part is omitted.
[0037] As the waveguide type light coupler module concerning the 5th example is shown in drawing 11 and 12, in case optical waveguide 31 and the optical fiber 11 of a multi-core photoconnector (8MT) 18 are adjusted with a guide pin 23, end-face 18a of the multi-core photoconnector 18 which the optical fiber 11 of the multi-core photoconnector (8MT) 18 contacted exposes, and optical ON outgoing radiation end-face 22a of optical waveguide 31 are aslant ground at the respectively equal include angle theta. The 5th example is for reducing the reflective return light by the Fresnel reflection produced in a part for the joint of the optical waveguide 31 of said 4th example, and the optical fiber 11 of a multi-core photoconnector (8MT) 18. For example, it prevents the reflected light by Fresnel reflection becoming trapped mode by performing highly precise angle lapping at the include angle theta of about 8 times or more about end-face 18a of the multi-core photoconnector 18 which 11 of an optical fiber exposes, and optical ON outgoing radiation end-face 22a of optical waveguide 31, and reduction of connection loss of the propagation light by Fresnel reflection can be aimed at.
[0038] [Example 6] Drawing 13 is the 6th example of this invention, the end view showing the relation between the optical waveguide substrate 32 and the guide pin holddown member 33 is shown, and drawing 14 is drawing showing the fitting condition of drawing 13 .
[0039] The cross-section configuration is formed in a reverse concave so that the guide pin holddown member 33 may enclose the top face and both-sides side of the optical waveguide substrate 32, as shown in drawing 13 and 14, and the waveguide type light coupler module concerning the 6th example is pinched for a guide pin 23 like said 4th example.
[0040] Since the limit is added to the magnitude of optical ON outgoing radiation end-face 22a in the 6th example as shown in drawing 13 , the both-sides sides 32a and 32b of the optical

waveguide substrate 32 have been deleted to this side of the guide slot 36, and it is the width of face D1 between 32b from side-face 32a. Inferior-surface-of-tongue 33a of the guide pin holddown member 33 is set up equally (D=D1) so that it may oppose. Moreover, the depth H1 by which inferior-surface-of-tongue 33a which opposes the optical waveguide substrate 32 was used as the concave streak Height H of the top-most vertices of a guide pin 23 is set up equally (H=H1) from inferior-surface-of-tongue 32c of the optical waveguide substrate 32. A guide pin 23 is pinched by the peripheral surface of the guide slot 36 of the optical waveguide substrate 32, and inferior-surface-of-tongue 33a of the guide pin holddown member 33, and adhesion immobilization is carried out with adhesives 35 in the both-sides sides 32a and 32b of the optical waveguide substrate 32.

[0041] The 6th example can perform immobilization of the guide pin 23 which has reinforcement more in immobilization of the guide pin 23 of said 4th example. Moreover, also in adhesion with the optical waveguide substrate 32 and the guide pin holddown member 33, there is outstanding effectiveness from which reinforcement adhesion immobilization is attained and the desorption to the guide slot 36 of a guide pin 23 also becomes possible.

[0042] [Example 7] Drawing 15 is the 7th example and is drawing showing the prototype configuration of the optical branching unit of this invention.

[0043] The 7th example made the optical branching unit as an experiment, as shown in drawing 15 , and it was able to attain simplification of an optical branching unit. As shown in this drawing, the extra length processing section is expressed with the wavy line, and a thing without the complexity by tape-izing is checked. Moreover, by standing the waveguide type light coupler module 22 sideways, and mounting it in a unit, there is neither torsion in the extra length processing section of the tape core wire 19 nor a strain, and attachment of the tape core wire 19 can be performed.

[0044] The measurement result of a prototype is shown in "Table 1." It is the result of carrying out about the waveguide type light coupler module 22 in this prototype using a straight-line waveguide type light module.

[0045]

[Table 1]

測定結果一覧表

心線 No.		#1	#2	#3	#4	#5	#6	#7	#8
接続損失(dB)		0.69	0.87	0.72	0.77	0.61	0.60	0.57	0.8(
反射減衰量(dB)		49	46	52	47	51	47	52	47
温度サイクル特性	MAX値(dB)	0.16	0.13	0.10	0.15	0.07	0.04	0.05	0.0(
	MIN値(dB)	-0.14	-0.05	-0.07	-0.16	-0.03	-0.02	-0.04	-0.0
	変動量(dB)	0.30	0.18	0.17	0.31	0.10	0.06	0.09	0.0
偏光Loss特性(dB)		0.09	0.11	0.14	0.12	0.10	0.05	0.10	0.07

[0046] Although the above 4th - the 6th example showed the case of the guide pin method which

formed the guide slot 36 for positioning in one to the optical waveguide substrate 32, this invention may not be restricted to this, and may form other configurations, optical waveguide, and the guide slot for positioning in each **, for example, may fix them correctly by position relation, respectively. Moreover, although the case where eight optical waveguides 31 were formed in the above-mentioned example was shown, this invention is not restricted to this, and even if it uses the case where many optical waveguides and optical fibers are joined, the effectiveness of this invention can be acquired. Moreover, various structures can be considered that optical branching is just performed as this optical coupler.

[Translation done.]